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FY 1992-1993 RDT&E Descriptive Summaries



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FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #001101E
 PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

A. RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
CCS-02 Information Sciences	34,933	36,261	40,000	40,000	Continuing	Continuing
DRG-01 Geophysical Research	2,700	0	0	0	0	28,348
DRH-01 Physical Sciences	7,450	4,700	0	0	0	131,382
ES-01 Electronic Sciences	22,711	21,787	28,700	24,395	Continuing	Continuing
LV-01 Laser Verification	0	8,000	0	0	0	8,000
MS-01 Materials Sciences	16,996	17,580	19,590	20,179	Continuing	Continuing
TOTAL	84,792	88,328	88,290	84,574		

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The Defense Research Sciences program element provides the technical foundation for long-term improvements in military equipment and systems through the discovery of new phenomena and the exploration of the potential of such phenomena for military application. It involves scientific study and experimentation directed toward knowledge and understanding in those fields of the physical, engineering, computer, and life sciences related to long-term national security needs. It forms a part of the base for (a) subsequent exploratory and advanced developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support. Funding for project DRG-01, Geophysics Research, was transferred to the Air Force in FY 1991 and Project DRH-01, Physical Sciences will not be funded in FY 1992 and beyond.

Stat. A. - per phonecon with Karen Schroeder (DARPA), tele. 614-5920.

Vic LaChance

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FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
 PE Title: Defense Research Sciences

Project Number: CCS-02
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
CCS-02 Information Sciences	34,933	36,261	40,000	40,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: Develop fundamental technology for smaller, more powerful, less expensive military systems using computer and information technology including artificial intelligence.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Developed integrated circuit design tools for creating applications specific integrated circuits that will be used as accelerator nodes in parallel computing systems.
- Demonstrated Very Large Scale Integrated (VLSI) circuits that combine analog and digital processing elements for higher performance and greater density.
- Developed military planning and decision support systems operating in a distributed computing environment.
- Expanded prototype case-based reasoning to test new case retrieval strategies and indexing schemes.
- Prototyped integrated intelligent architectures for machine learning and problem-solving.

FY 1991 Planned Program:

- Develop VLSI architecture and design efforts to allow development of integrated capabilities for design, fabrication, and test of integrated circuits containing in excess of one million gates and rapid prototyping of systems containing such circuits.
- Implementation of intelligent user interfaces combining natural language and user workflow model information.
- Determine effectiveness of auditory models as preprocessors for robust speech recognition in noise.
- Demonstrate automatic programming of robotic manipulation for complex manufacturing assembly tasks.
- Demonstrate advanced strategies for indexing and retrieving design knowledge.
- Evaluate ability of message understanding systems to extract crisis-situation data from news wires.
- Evaluate alternative integrated intelligent architectures for machine learning and problem-solving.
- Explore single-intermediate-language approach to machine translation.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: CCS-02

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

- Develop 50 Million Instructions Per Second (MIP) self-timed microsystem node for advanced parallel computers.

FY 1992 Planned Program:

- Demonstrate ability of message understanding systems to handle a variety of subject domains and text styles.
- Develop and demonstrate advanced methods to automatically capture and reason with design histories during the system life cycle.
- Develop specifications of language to specify interconnections among modules in software systems in order to enable heterogeneous software systems.
- Prototype most promising integrated intelligent architectures for machine learning and problem-solving.
- Develop initial integrated support system for generic knowledge representations and services.
- Develop chips, synthesis capabilities for fault-tolerant microsystems router.
- Develop 100 MIP microsystem processor.

FY 1993 Planned Program:

- Demonstrate design reuse and automated design history capture in a variety of diverse subject domains.
- Apply component interconnection language to precisely define interfaces in existing systems software in order to facilitate development of systems with high levels of confidence of correctness.
- Demonstrate data model for software configuration record that links code, specification, test cases, repository pointers, access rights, design rationale, metric data, and other information in a manner that enables long life-cycle software support.
- Evaluate and refine integrated support system for generic knowledge representations and services.
- Develop fault-tolerant microsystem router, perform fault injection experiments.

D. WORK PERFORMED BY: University of Southern California/Information Sciences Institute, Marina del Ray, CA; Stanford University, Palo Alto, CA; Massachusetts Institute of Technology, Cambridge, MA; University of California at Berkeley, CA; Carnegie-Mellon University, Pittsburgh, PA; New York University, New York, NY; SRI International, Menlo Park, CA; New Mexico State University, Las Cruces, NM; University of Rochester, Rochester, NY; and Bolt Beranek and Newman, Cambridge, MA.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
 PE Title: Defense Research Sciences

Project Number: ES-01
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
ES-01 Electronic Sciences	22,711	21,787	26,700	24,395	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project explores and demonstrates device, material, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering, and processing; and (2) substantial increase in performance and cost reduction per function. Areas included are: advanced semiconductor processing, biologically derived materials, new device and circuit concepts, reliability and availability of electronics at reduced costs, innovative optical materials and devices, and artificial neural networks (ANN) hardware.

C. PROGRAM ACCOMPLISHMENTS AND PLAN:

FY 1990 Accomplishments:

- Demonstrated 8-bit 180 megahertz, acoustic charge transfer 256 tap digitally programmable transversal filter.
- Developed 3-dimensional optical storage materials.
- Developed resonant tunneling devices.
- Developed low threshold, high frequency arrays of individually addressable vertical cavity lasers.
- Demonstrated 94 GHz transistors with 6 db gain.

FY 1991 Planned Program:

- Develop high frequency, above 20 GHz, laser modulation techniques.
- Implement lift-off processing technique to achieve versatile optoelectronic circuits.
- Develop coupled quantum well optical switches.
- Demonstrate multiple quantum device circuits.
- Demonstrate mercury-cadmium-telluride (MCT) on gallium arsenide (GaAs) infrared focal planes (IRFPAs).
- Demonstrate a III-V long wave infrared detector array.
- Show neural nets out-performing conventional techniques.

FY 1992 Planned Program:

- Fabricate integrated optical processing modules of photorefractive elements and electronics devices.
- Formulate stable organic electro-optical polymers.
- Demonstrate growth of device quality mercury-cadmium-telluride (MCT) on 3-inch wafers of gallium arsenide by molecular beam epitaxy.
- Investigate nearest neighbor interaction cellular automata architectures, using quantum devices.
- Demonstrate logic elements using quantum devices.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: ES-01

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

- Demonstrate high current density, long lifetime and high brightness performance of advanced cathode materials.
- Fabricate neural net hardware for sonar, speech, image, and seismic recognition systems.

FY 1993 Planned Program:

- Develop pigtailed bistable diode laser amplifier arrays.
- Develop coupled, quantum-well optical switches.
- Demonstrate blue-green diode laser.
- Demonstrate low-cost, high responsivity III-V long wave infrared focal plane arrays.
- Show neural net data fusion, control, and diagnostics.
- Characterize crystalline amino acids.
- Demonstrate speech compression with Artificial Neural Networks (ANN) hardware.

D. WORK PERFORMED BY: Rockwell International Science Center, Thousand Oaks, CA; Westinghouse Research Center, Pittsburgh, PA; Stanford University, Palo Alto, CA; Lincoln Laboratory, Lexington, MA; ATT/BELL Labs, Holmdale, NJ; Martin Marietta Labs, Baltimore, MD; Allied Signal, Columbia, MD; and Texas Instruments, Dallas, TX.

E. RELATED ACTIVITIES: Efforts in this project are coupled to the Services' program through use of service agents, annual DoD-wide program reviews, and presentations to the Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E Project Number: MS-01
 PE Title: Defense Research Sciences Budget Activity: 1. Technology Base

A. RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Actual</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MS-01 Materials Sciences	16,998	17,580	19,590	20,179	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This program is concerned with the development of new materials and concepts for advanced composite structures; synthesis of stronger and more heat resistant polymers; development of high power/energy density electrochemical power sources, including batteries and fuel cells; and research into means of disposing future generation toxic chemical wastes.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Discovered a new class of piezoelectric polymers for high temperature sensor applications.
- Demonstrated drag reduction using polymers.
- Developed all solid state batteries that have 5 times the energy density, and 100 times the shelf life of Nickle Cadmium batteries.
- Initiated new program to develop process for uniformly coating fibers for use in composites.
- Developed a method for the fractionation of petroleum pitch with supercritical fluids.

FY 1991 Planned Program:

- Initiate a program in electroprocessing of piezoelectric materials for sonar applications.
- Initiate a program to produce advanced boron nitride fibers for composite reinforcement.
- Develop super critical fluid technology for the safe destruction of toxic military wastes.
- Establish pilot line to produce high quality, all solid state batteries.
- Fabricate ceramic matrix composites using microwave assisted chemical vapor infiltration.

FY 1992 Planned Program:

- Demonstrate stable, high temperature, nylon piezoelectric polymers.
- Demonstrate high-efficiency methanol fuel cell.
- Demonstrate scale-up of all solid state batteries to 33 amp hours and 12 volts.
- Demonstrate highly sensitive, fast, low cost sensors for chemical agents.

FY 1992/1993 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: MS-01

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

- Demonstrate applicability of Lanxide metal matrix composite technology for advanced electronic packaging.

FY 1993 Planned Program:

- Initiate construction of pilot plant for safe destruction of toxic military chemical wastes.
- Development of electrocatalysts for the efficient ambient temperature fuel cells.
- Demonstration of high-efficiency methanol fuel cell power module.
- Demonstrate next generation boron nitride fiber for composite reinforcement.

D. WORK PERFORMED BY: University of Pennsylvania, Philadelphia, PA; Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; Lanxide Corp., Newark, DE; GA Technologies, La Jolla, CA; University of California, Santa Barbara, CA; International Fuel Cells, South Windsor, CT.

E. RELATED ACTIVITIES: DARPA's research in Materials Sciences is coordinated within the DoD and with other federal agencies via the NSF-hosted Interagency Materials Group, OSTP's Committee on Materials (COMAT), and various Director Defense Research and Engineering (DDR&E) sponsored topical workshops on advanced materials. These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Strategic Technology Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
ST-01 JASONS	2,575	1,280	1,300	1,300	Continuing	Continuing
ST-10 Strategic Computing	100,150	0	76,375	99,495	Continuing	Continuing
ST-11 Intelligent Systems	33,935	31,355	34,560	35,000	Continuing	Continuing
ST-12 Advanced Quantum Electro-Optics and Electronic Warfare	12,384	14,765	17,544	20,000	Continuing	Continuing
ST-15 Gallium Arsenide	28,900	22,400	8,836	0	0	138,071
ST-16 High Temperature Superconductivity/Ceramics	27,878	26,062	23,365	25,000	Continuing	Continuing
ST-18 DARPA Initiative in Concurrent Engineering (DICE)	30,000	25,000	0	0	0	55,000
ST-19 High Performance Computing (HPC)	0	119,638	106,400	150,800	Continuing	Continuing
<u>TOTAL</u>	<u>235,822</u>	<u>240,500</u>	<u>268,380</u>	<u>331,595*</u>		

*Includes the Defense Business Operations Fund (DBOF)

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This Program Element funds exploratory development projects directed toward the application of advanced, innovative strategic technologies associated with: systems concepts; strategic computing; intelligent systems; advanced solid state lasers; surveillance and engagement techniques; manufacturing technology; processing, fabrication and demonstration of high temperature ceramic superconductors; and the applications of high performance computing technologies to defense problems in teraops computing systems, associated software technology and gigabits networking technology. In FY 1993, this Program Element reflects funding associated with the Defense Business Operations Fund (DBOF).

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #602301E
 PE Title: Strategic Technology

Project Number: ST-01
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-01	JASONS 2,575	1,280	1,300	1,300	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project supports the JASONS, an independent group of distinguished individuals dedicated to sophisticated scientific and technical research and analysis in support of the National Security Community. JASONS' membership is carefully balanced to provide a wide spectrum of expertise in theoretical and experimental physics, materials, information sciences, and other allied disciplines.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments: The JASON Group has conducted investigations involving: detection of low radar cross-section airborne vehicles, directed energy effects, underwater vehicles, neutrino detection, speech, tailored nuclear weapons, hypervelocity, nanosecond timing, and MAD/RPV.

FY 1991 Planned Program: The JASON Group at the MITRE Corporation will conduct extensive investigations of topics such as: advanced phase array technology, foliage penetration radar, condensed charge technology, high energy density explosives, impulse radar, and structural acoustics.

FY 1992 Planned Program: Continuing evaluations of new technical issues as they arise.

FY 1993 Planned Program: Continuing evaluations of new technical issues as they arise.

D. WORK PERFORMED BY: Mitre Corporation, McLean, VA.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Project Number: ST-10
 PE Title: Strategic Technology Budget Activity: 1 Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u>						
<u>Number &</u>	FY 1990	FY 1991	FY 1992	FY 1993	To	Total
<u>Title</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
ST-10	Strategic Computing					
	100,150	(119,638)*	76,375	99,495**	Continuing	Continuing

* Shown here for purpose of continuity. This program will be executed under ST-19 in accordance with the FY 1991 Appropriation Act.

** Includes funds associated with the Defense Business Operations Funds.

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: Develop a new generation of computing technology, with emphasis on the further development of high performance computing for defense embedded systems and other defense applications. Develop advanced computational methods, including symbolic, numeric, and combined approaches from artificial intelligence and computational mathematics. Create embeddable versions of high performance computing modules for use in defense systems, requiring low power, high density, and heterogeneity. Develop systems software for scalable, portable, and trusted heterogeneous computing. Create advanced software capabilities for computationally intensive defense uses including image understanding, signal understanding, antisubmarine warfare speech recognition, logistics support, and vehicle design. Create foundations for supporting advanced acquisition technology that will enable the design, development, manufacturing, and logistics support for weapon systems, as well as command and control, and mission critical information processing.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Dynamic Analysis and Replanning Tool (DART) prototyped, refined, now in routine use by US Transcom, reducing transportation planning times from several days to 3 hours.
- Integration of AI-based, adaptive methods yielding 500% improvement in manufacturing planning and control applications.
- Halved error rate for recognition of large vocabulary continuous speech.
- Machine Intelligence technologies using parallel computing will demonstrate performance approaching real time.
- Demonstrated an additional second-generation parallel computing system with performance of over 10 billion operations per second (gigaops).
- Experimentally confirmed, for the first time, theory about time-periodic fluid state to clarify an important phenomena in fluid dynamics.
- Developed highly parallelizable algorithms for the simulation of electromagnetic waves in non-planar thin films.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-10

PE Title: Strategic Technology

Budget Activity: 1. Technology Base

- Developed new image compression algorithms using wavelets.
- Demonstrated the world's most complex digital multichip module - four coupled signal processors with a throughput of 180 million instructions per second.
- Demonstrated additional advanced technologies such as wafer-scale VLSI-designs, and parallel software synthesis.
- Developed large-scale speech-monitoring techniques for command and control and other applications.
- Demonstrated Corps/Division level integrated battle management system.
- Initiated development of advanced image processing systems to meet defense high definition display requirements.

FY 1991 Planned Program (funding in ST-19):

- New generation vision system architecture for integration of motion detection modules, terrain modelling modules, sensor fusion processes in near-real time.
- Flexible planning and scheduling systems capable of rapid modification in resource constrained, dynamic applications.
- Real-time recognition of continuous speech with 1,000-word vocabulary that can adapt rapidly to a new speaker.
- Demonstrate a large-scale aerodynamic simulator prototype on a 10 gigaops scalable parallel computing system.
- Laboratory demonstrations of computing system capable of 100 billion operations per second.
- Rapid acquisition of commercial electronic components transitioned to DoD.
- Extend and continue to apply knowledge-based system for transportation planning and scheduling.
- Prototype flexible planning system capable of rapid modification in resource constrained dynamic applications. Single Integrated Operations Plan (SIOP) will be the problem domain for technology demonstration.
- Initiate development of automated natural language text detection and extraction capability.
- Demonstrate operation of a smart 2D optical detector array.
- Test new algorithms for underwater feature detection of sound (ASW) using wavelets and Gabor theory.
- Develop manufacturable, reliable 3D memory for clock rates above 100 MHz.

FY 1992 Planned Program:

- Prototype of spoken language understanding for interactive problem solving.
- Prototype of large-scale interactive knowledge-based transportation planning aid.
- Develop optical crossbar switches with low insertion losses and fast reconfiguration time.
- 200 MHz Gallium Arsenide digital processor in High Density Interconnect.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-10

PE Title: Strategic Technology

Budget Activity: 1. Technology Base

- Demonstrate 8x real-time speech sorting and real-time gisting capability.
- Prototype of text sorting and gisting capability.
- Prototypes of machine vision environment capabilities.
- OS support for 1000 node multicomputers including fast file repositories, scheduling, checkpointing, restart and read-time control.
- Completion and evaluation of rapid SIOP planning capability.
- Demonstration of prototype industrial computing systems capable of 100 billion operations per second.
- Develop microsystems architectures and prototype components for teraops-scalable computational units of replication.
- Demonstrate 200 MHz gallium arsenide digital processors.
- Fabrication of a 3D optical mass storage medium.
- Initial computational prototyping of semiconductor factory capability.
- Develop scalable, embeddable high-density computing modules with gigaops performance.
- Develop new algorithms for spread spectrum based on wavelet theory.

FY 1993 Planned Program:

- Develop 2 photon, 3 dimensional optical memory.
- High yield, 100 MHz MCM demonstrations from foundries.
- Apply and refine prototype of large-scale, interactive, knowledge-based transportation planning aid.
- Enhance accuracy and robustness of text detection and extraction capability.
- Develop robust machine vision environment.
- Laboratory demonstration of teraop-scalable multicomputer technology.
- High-yield, 100-250 MHz multi-chip module demonstrations.
- Demonstration of 100 billion ops/second computing on DoD applications.
- Initiate application of advanced machine planning and learning capabilities to DoD planning and assessment applications.
- Demonstrate scalable, embeddable computing modules in military applications.
- Demonstrate low cost, high performance modules to build scalable hardware.
- Demonstrate a prototypical system for spread spectrum communication based on wavelets.

D. WORK PERFORMED BY: General Electric Corporation, Schenectady, NY; Bolt, Beranek and Newman, Cambridge, MA; Carnegie-Mellon University, Pittsburgh, PA; Stanford University, Palo Alto, CA; Intel Corporation, Santa Clara, CA; David Sarnoff Labs, Princeton, NJ; Texas Instruments, Dallas, TX; Massachusetts Institute of Technology, Cambridge, MA; UNISYS Defense Systems, Paoli, PA; SRI International, Menlo Park, CA; AWARE Inc., Cambridge, MA; Atlantic Aerospace and Electronics Corp., Greenbelt, MD.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-10

PE Title: Strategic Technology

Budget Activity: 1. Technology Base

E. RELATED ACTIVITIES: Program Element #0602301E, Strategic Technology, ST-19 High Performance Computing. With the initiation of ST-19 (High Performance Computing), ST-10 (Strategic Computing) will more explicitly focus on defense embedded high performance systems, on accelerators for specific defense problem domains, on integration of machine intelligence technology into high performance systems, and on experimental application of high performance systems for critical defense problems.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301
PE Title: Strategic Technology

Project Number: ST-11
Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
ST-11 Intelligent Systems	33,935	31,335	34,560	35,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF PROJECT: Investigates sciences and technologies that promise fundamentally new software capabilities and intelligent information processing. This will enable computers to amplify or augment military personnel performing complex decision-making, tasks in stressful, time sensitive situations. A major emphasis is rapid prototyping and life cycle support technology of next-generation computing systems for defense needs that are flexible, robust, and cost-effective. Major areas of technical emphasis include languages, algorithms, systems software, and design tools. The major focus continues to be development of artificial intelligence (AI) systems and supporting technologies.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Demonstrated scalable AI architectures for distributed problem solving.
- Demonstrated automatic geometric reasoning on simple objects.
- Demonstrated enhanced image processing based on an integrated three-layer processing strategy implemented in hardware on an advanced multi-stage accelerator.
- Demonstrated low-cost, reliable, microprocessors with integrated signal conditioning and multiplexing for application to intelligent and reliable military systems.
- Demonstrated a new class of real-time AI-based problem solving techniques.

FY 1991 Planned Program:

- Demonstrate capabilities for automatic scene segmentation initial automatic multiple-goal planning capabilities and automatic geometric reasoning capability for classifying multiple (more than 10) moderately complex objects in a scene.
- Continue research in cooperative problem solving, reasoning with uncertainty, image understanding, ST-10 to increase functionality and performance.
- Develop advanced reasoning techniques to capture designs and automatically generate diagnostic and monitoring knowledge.
- Expand area and scope capabilities of aerial image interpretation, integrate with terrain data bases.
- Demonstrate languages and systems software to support symbolic and numeric processing applications on high performance heterogeneous parallel systems, including network-based systems.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301
PE Title: Strategic Technology

Project Number: ST-11
Budget Activity: 1. Technology Base

FY 1992 Planned Program:

- Develop standards to facilitate reuse of AI methods and knowledge bases.
- Develop common image understanding, planning, and testbed framework machine learning to accelerate research progress.
- Develop generic, intelligent problem solving tools based on the integration of machine learning, knowledge representation, and planning methods.
- Demonstrate new AI tools in very large scale, distributed experiments in areas such as weapon system software design, logistics, and operations planning.
- Develop prototype implementation of high-level language to support rapid prototyping of software systems.
- Demonstrate capabilities of simulated and virtual factory for semiconductor process design.

FY 1993 Planned Program:

- Develop robust capability for automatic scene segmentation.
- Demonstrate automatic geometric reasoning capability for classifying many (more than 100) moderately complex objects in a scene.
- Demonstrate complex automatic multiple-goal planning capabilities.
- Develop architecture for software environment to support rapid prototyping and integration of prototype modules into evolving software systems.

D. WORK PERFORMED BY: Stanford University, Palo Alto, CA; University of Southern California, Information Sciences Institute, Marina del Ray, CA; Carnegie-Mellon University, Pittsburgh, PA; Harvard University, Cambridge, MA; Computational Logic, Incorporated, Austin, TX; University of California at Berkeley, CA; Rice University, Houston, TX.

E. RELATED ACTIVITIES: PE #0602301E, ST-10 Strategic Computing is based on machine intelligence research performed under this project.

F. OTHER APPROPRIATIONS FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
 PE Title: Strategic Technology

Project Number: ST-12
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
ST-12	Advanced Quantum Electro-Optics and Electronic Warfare					
	12,384	14,765	17,544	20,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The purpose of this project is to: advance the technology of quantum electro-optics (EO) for sensor protection; develop 193-nm wavelength optics; and to develop techniques for countering monopulse radar. It also combines modeling and simulation with experimentation for a variety of DoD applications including radars, communications, turbulence, distributed memory machines and control theory. In particular, the quantum EO program develops materials and devices to protect human eyes and EO sensors against broadband, frequency agile, and short-pulse laser threats.

The objective of the Applied and Computational Mathematics Programs is to combine modeling and simulation with experimentation for a variety of DoD applications. Examples are: application of wavelets to problems in radar and spread spectrum communications; fluid dynamic studies of noise generation by turbulence; improved linear algebraic computation using advanced distributed memory machines; and improved manufacturing capability by application of intelligent control theory.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Developed enhanced nonlinear optical materials for eye and sensor protection against tunable lasers.
- Demonstrated the microlens array with a gain of 10⁴.
- Developed microsurgical techniques to treat laser-related acute eye injuries.
- Demonstrated 193 nano-meters (nm) optical materials.
- Initiated program to counter monopulse radar.
- Developed two-color, voltage selectable, mercury cadmium telluride IR detector.

FY 1991 Planned Program:

- Evaluate nonlinear materials for eye/sensor protection against pulsed tunable laser threats.
- Develop 193 nanometer focusing optics.
- Perform simulation of Cooperative Angle Jamming technique.
- Initiate program for noncooperative target identification.
- Develop control models for diamond film deposition.
- Improve speech compression by a factor of 5.

FY 1992 Planned Program:

- Develop prototype protective devices from promising nonlinear materials.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-12
Budget Activity: 1. Technology Base

- Fabricate and test Cooperative Angle Jamming system.
- Transfer to NSA results and methodology for solving satellite clock-locking problems.

FY 1993 Planned Program:

- Evaluate prototype devices for sensor protection.
- Perform flight testing of Cooperative Angle Jamming against ground-base monopulse tracking radar.
- Develop intelligent manufacturing process control theory and apply to industrial manufacturing setting.
- Develop new electromagnetic code for stealth technology and electronic chip design.
- Develop new code describing the physics and chemistry of internal combustion engines.

D. WORK PERFORMED BY: Lincoln Laboratory, Lexington, MA; Boeing Aerospace, Seattle, WA; Rockwell Science Center, Thousand Oaks, CA; Lockheed Missile & Space Company, Palo Alto, CA; Martin Marietta Company, Baltimore, MD; E-Systems, Falls Church, VA; Stanford University, Palo Alto, CA; University of California, Berkeley, CA; and Yale University, New Haven, CT; National Institute of Standards and Technology, Gaithersburg, MD.

E. RELATED ACTIVITIES: The Eye/Sensor Protection Program is coordinated with the Army Advanced Laser Protection Program through a Memorandum of Agreement (MOA) between US Army LABCOR and DARPA. Army and DARPA technology programs complement and support each other. The Applied and Computational Mathematics Program is coordinated with ONR, AFOSR, NSF, and NSA, thus ensuring that there is no undue overlap.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
 PE Title: Strategic Technology

Project Number: ST-15
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u>						
<u>Number</u>	FY 1990	FY 1991	FY 1992	FY 1993	To	Total
<u>& Title</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
ST-15	Gallium Arsenide Applications					
	28,900	22,400	8,836	0	N/A	60,136

B. BRIEF DESCRIPTION OF PROJECT: This project demonstrates the military advantages of digital gallium arsenide (GaAs) subsystems for upgrading fielded systems, including electronic countermeasures, surveillance, and intelligence systems. The DARPA efforts will result in prototypes that the relevant Service program offices have agreed to test, qualify, and procure as upgrades. Complementary efforts are establishing key advanced digital GaAs components. The project also includes an effort to demonstrate the technology for conformal microwave transmit/receive (T/R) modules ("smart skins"), an effort that concludes in FY 1991.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Designed GaAs processor for 8 times faster signal processing on RC-135 reconnaissance aircraft.
- Designed GaAs signal processor for OH-58D upgrade.
- Demonstrated 150 megahertz GaAs central processing unit chip at low power.
- Demonstrated complete whole wafer T/R cells and packaging, the cells had a 62.5% yield and provide 10.5 watt output over 6 to 10.5 gigahertz.
- Achieved world's fastest 5-bit analog to digital converter capable of 1.2 gigasamples per second.
- Demonstrated gigabaud/second transmit/receive chip set.

FY 1991 Planned Program:

- Demonstrate GaAs components for 7 times faster On-Board Processor.
- Demonstrate fieldable GaAs digital radio frequency memories to allow tactical aircraft to jam new classes of threat radars.
- Demonstrate AN/PRC-126 small unit radio that is interoperable with Army standard radios.
- Demonstrate AN/APS-137 radar capable of double present resolution.
- Demonstrate 16K GaAs memory with power-down switch.
- Integrate T/R cells and packaging into 5 working subarrays.
- Demonstrate incorporation of high dielectric constant capacitors in memory cells to achieve single event upset (SEU) immunity.

FY 1992 Planned Program:

- Demonstrate spacecraft On-Board Processor.
- Demonstrate missile seeker upgrade for 10% cost savings.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-15
Budget Activity: 1. Technology Base

- Achieve 2.5 gigasamples per second, 5-bit (A/D) converter.
- Fabricate 16 kilobit, SEU free, 10 nanoseconds access time, static, random access memory needed for classified spacecraft.
- Demonstrate 200 megahertz, reduced instruction-set computer needed as general purpose control computer in digital performance systems.

D. WORK PERFORMED BY: Major contracts include E-Systems, Greenville, TX, and St. Petersburg, FL; Martin Marietta, Denver, CO, and Orlando, FL; Westinghouse, Baltimore, MD; Texas Instruments, Dallas, TX; Rockwell, Newbury Park, CA; and McDonnell Douglas, Huntington Beach, CA.

E. RELATED ACTIVITIES: This project is the only DoD effort to insert digital gallium arsenide technology into fielded military systems. The work is coordinated with Service research efforts through the Advisory Group on Electron Devices. These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
 PE Title: Strategic Technology

Project Number: ST-16
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
SI-16 High Temperature Superconductivity/Ceramics	27,878	26,062	23,365	25,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project involves processing, fabrication and demonstration of high temperature (transition temperatures, T_c , greater than 77 degrees Kelvin) ceramic superconductors (HTSC's) in thin films, wires, tapes and devices processed to achieve required critical current (J_c) carrying capability, magnetic properties, mechanical behavior and long-term stability. Ultimate applications include Analog/Digital (A/D) converters, analog and digital devices, gyroscopes, accelerometers, motors, bearings, Superconducting Quantum Interference Devices (SQUIDS), magnets and energy storage, Radio Frequency (RF) cavities, antennas and Infrared (IR) sensors. Primary attention is also given to manufacturing issues.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Funded Consortium for Superconducting Electronics to develop HTSC electronic components.
- Fabricated thin film HTSC microwave components.
- Demonstrated HTSC wire with critical current density of 10,000 A/cm² at 77K and 1 Tesla magnetic field.
- Demonstrated 4-bit analog-to-digital converter using HTSC SQUID's in counter chain.

FY 1991 Planned Program:

- Construct motor of 3hp or greater power using HTSC materials.
- Demonstrate IR sensor array based on HTSC infrared detector elements.
- Begin programs integrating passive HTSC microwave components into EW and communications systems.
- Develop broad area (at least 2-inch diameter) HTSC film deposition capability.

FY 1992 Planned Program:

- Produce and evaluate wire of bismuth-based HTSC material with higher transition temperature and better current carrying capability within magnetic fields.
- Evaluate 2-dimensional addressable HTSC sensor array with broadband IR response for 2D sensor arrays.
- Demonstrate HTSC microwave component operation in Navy satellite space experiment.
- Develop SQUID application to Navy Anti-Submarine Warfare efforts.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-16
Budget Activity: 1. Technology Base

FY 1993 Planned Program:

- Formulate insertion of HTSC active electronics into digital signal processors and general purpose computers.
- Demonstrate systems application of integrated HTSC RF components in electronic warfare and communications.
- Undertake insertion of bulk superconductors into specific defense hardware such as gyroscopes, accelerometers, and small motors.
- Evaluate packaging methods for mature HTSC electronic components.

D. WORK PERFORMED BY: Major performers include: Superconductor Technologies, Inc., Goeleta, CA; GA Technologies, La Jolla, CA; Massachusetts Institute of Technology, Cambridge, MA; University of California, Santa Barbara, CA; University of Houston, Houston, TX; Honeywell Corp., Minneapolis, MN; and Ceramic Process Systems, Milford, MA.

E. RELATED ACTIVITIES: Research on high temperature superconductors (HTSC) is coordinated within DoD and with other federal agencies via the Office of Science and Technology Policy (OSTP) Committee on Materials (COMAT), HTS Coordinating Committee, the NSF-hosted Interagency Materials Group, and numerous workshops involving industry, universities and government laboratories.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATION AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-19
Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u>						
<u>Number</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>& Title</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
ST-19	High Performance Computing					
	0	119,638*	106,400	150,000	Continuing	Continuing

*In FY91, the budget includes the total Strategic Computing and High Performance Computing effort. For FY92 and beyond, Strategic Computing (ST-10) and High Performance Computing are separated in order to enable identification of High Performance Computing efforts.

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: Advance High Performance Computing and computer Communications (HPCC) technology and its application to defense problems, leading to teraops computing systems, associated software technology, and gigabits networking technology. These results will be used by ST-10 (Strategic Computing) and other DARPA and Defense programs for experimental application to critical defense problems including embedded high performance systems. HPCC program efforts include microsystems component technology and advanced packaging, systems software technology, algorithms and programming tools for parallel heterogeneous systems, switches and protocols for gigabits capacity networks, and early use of experimental systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments: Not applicable.

FY 1991 Planned Program:

- Initiation of High Performance Computing Program through a Broad Agency Announcement process.
- Select designs for teraops computing systems, including systems software.
- Select major systems software and tools for parallel systems.
- Begin experimental use of wide area file system.
- Select projects to develop advanced network services.

FY 1992 Planned Program:

- Demonstrate 100 gigaops high performance computing systems.
- Prototype software libraries for scalable parallel computers.
- Demonstrate prototype high density interconnect module for future systems.
- Prototype advanced software design tools for parallel software systems.
- Early use of national file system technology for software distribution.
- Demonstrate heterogeneous operating systems technology for high performance computing system.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E
PE Title: Strategic Technology

Project Number: ST-19
Budget Activity: 1. Technology Base

- Demonstrate scalable mass storage.

FY 1993 Planned Program:

- Distribute prototype HPC software library for experimental use using wide area file system.
- Define architecture for nationwide gigabit network.
- Demonstrate major modules of one-tenth scale teraops high performance computing systems.
- Demonstrate scalable operating systems suitable for heterogeneous teraops computing.

D. WORK PERFORMED BY: Contractors in industry and universities will be selected through a competitive process. For FY91, contractors associated with the Strategic Computing effort are shown in ST-10.

E. RELATED ACTIVITIES: Program Element #0602301E, Strategic Technology, ST-10 Strategic Computing. With the initiation of the High Performance Computing program, Strategic Computing will more explicitly focus on embedded high performance systems, on accelerators for specific problem domains, on integration of machine intelligence technology into high performance systems, and on experimental application of high performance systems for critical defense problems. The results of ST-19 will also be used by other DARPA and DoD programs to initiate prototype development for computationally intensive defense problems.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-03 Undersea Warfare Technology	20,000	47,732	55,000	50,000	Continuing	Continuing
TT-04 Close Combat Technology	17,000	12,840	13,000	10,000	Continuing	Continuing
TT-05 Target Acquisition Technology	25,870	19,738	22,700	19,566	Continuing	Continuing
TT-06 Advanced Tactical Technology	13,075	14,851	12,000	15,000	Continuing	Continuing
TT-07 Aeronautics Technology	10,666	26,522	8,200	10,000	Continuing	Continuing
TT-08 Lighter Than Air Tech	27,000	0	0	0	0	55,438
TT-09 Counter-Drug Technology	<u>0</u>	<u>6,500</u>	<u>0</u>	<u>0</u>		6,500
PE Total*	114,611	128,183	117,900	111,866		

*Total includes classified project not identified herein.

B. BRIEF DESCRIPTION OF ELEMENT: This program element is dedicated to the advancement of research and development of concepts and technologies directed toward the development of the next generation tactical systems. The goal is to advance non-nuclear, tactical, combat capabilities to counter the expanding tactical threat. The major development objectives are: (1) to enhance undersea warfare technology by focusing on ASW capabilities in the area of sensor systems and information processing; (2) to support lighter more deployable forces in close combat technology; (3) to improve target acquisition and weapons technology by developing sensor and processing techniques for future tactical weapons; (4) to develop advanced lasers for a broad spectrum of tactical military applications in tactical directed energy technology; and (5) to produce effective and affordable aerospace technology systems. Project TT-09, Counter-Drug Technology, has been added in FY 1991. The objective of this project is to enhance DoD technical capabilities to support the detection and monitoring of the maritime and aerial transit of illegal drugs into the United States.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
 PE Title: Tactical Technology

Project Number: TT-03
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-03 Undersea Warfare	20,000	47,732	55,000	50,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The project develops and demonstrates technologies that will improve our Anti-Submarine Warfare (ASW) capabilities. It will explore the limits of sensor systems used separately and in combination. The project will develop innovative technologies for Acoustic Warfare to help decision-makers understand and utilize current environmental conditions, provide effective countermeasures, improve all-source cueing capability, and support management of platforms and ASW search systems, particularly long-range active systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Evaluated the performance gain from beamforming using array data.
- Demonstrated feature extraction algorithms.
- Gathered data for evaluation neural nets.

FY 1991 Planned Program:

- Develop and evaluate technology to be used in the conduct of acoustic warfare prediction, signal processing, countermeasures and target-cueing methods.
- Demonstrate advanced semi-automatic, processing and beamforming.
- Develop and test algorithms for signal processing and data fusion for Autonomous Target Acoustic Relocalization System.
- Complete sensor data analysis.
- Develop light-weight, low-cost, high-power, very-low-frequency, acoustic source for multi-static use.

FY 1992 Planned Program:

- Demonstrate processing algorithms.
- Test advanced multistatic processor technology at sea.
- Demonstrate automated, passive-acoustic, sonar scene-description system at sea on a SURTASS ship.
- Demonstrate mine detection and classification with recorded data.

FY 1993 Planned Program:

- Demonstrate multi-sensor fusion system using real-time data for Anti-Submarine Warfare (ASW).
- Demonstrate a commander's Acoustic Warfare tactical decision aid.
- Demonstrate technologies for an ASW Unmanned Underwater Vehicle.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-03
Budget Activity: 1. Technology Base

- Demonstrate mine detection multi-sensor data fusion and sensor.

D. WORK PERFORMED BY: AT&T-Bell Laboratories, Whippany, NJ; Orincon Corporation, San Diego, CA; General Dynamics Corporation, Arlington, VA; Science Applications International, McLean, VA; John Hopkins University, Laurel, MD; Naval Research Laboratory, Washington, DC; and Naval Undersea Systems Center, New London, CT.

E. RELATED ACTIVITIES: The U.S. Navy SPAWAR and Office of Naval Technology program in ASW has been fully coordinated to ensure that there is no duplication of effort.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-04	Close Combat Technology 17,000	12,840	13,000	10,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project supports lighter, more deployable forces including special technologies for improving survivability, advanced warheads and projectiles, smart mines, mine detection technologies and advanced engine technologies. DARPA funding of the joint Armor/Anti-Armor program essentially ends in FY92.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Developed, fabricated and tested light, efficient armor concepts.
- Tested advanced heavy metal Chemical Energy (CE) and Kinetic Energy (KE) warheads.
- Performed full-scale testing.
- Demonstrated 9 MegaJoule (MJ) Electromagnetic (EM) guns and hypervelocity projectiles.
- Began fabrication of mobile mine detectors and test of minefield command/control systems.
- Designed and fabricated Turbo-Roto-Compound (TRC) diesel engine monocylinder test rig.

FY 1991 Planned Program:

- Continue development and testing of enhanced penetrators.
- Test advanced Chemical Energy (CE) concepts.
- Conduct contractor tests of advanced modular armor concepts.
- Begin competitive test of ground-mobile countermining technology.
- Complete testing and transition to Army of mine command/control system.
- Demonstrate working prototype of advanced roto-turbo compound diesel engine.

FY 1992 Planned Program:

- Initiate selected new smart mine brassboard developments.
- Complete testing of ground-mobile mine detection testbeds.
- Initiate technology development for new advanced survivable light vehicles.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base

- Fabricate and test advanced air management system for Turbo Roto Compound (TRC) diesel engine.

FY 1993 Planned Program:

- Brassboard and test new smart mine concepts.
- Continue advanced vehicle survivability technology.
- Begin test of airborne mine detection technologies.
- Design, fabricate, and test 3-cylinder prototype Turbo Roto Compound (TRC) diesel engine.

D. WORK PERFORMED BY: The major performers are Los Alamos National Laboratory, Los Alamos, NM; Lawrence Livermore National Laboratory, Livermore, CA; University of Texas, Austin, TX; Dupont, Wilmington, DE; Detroit Diesel Corporation, Detroit, MI; and Engine Corporation America, Anaheim, CA.

E. RELATED ACTIVITIES: The DARPA Joint Armor/Anti-Armor Program is coordinated with the U.S. Army (PE 0602618A, Project AH81) and Marine Corps (PE 0603635N) programs in this area. Other related DARPA programs are covered in PE 0603226E, Project EE-21, Close Combat. Balanced Technology Initiative (BTI) PE 0603737D funds also support Mine/Countermine technology.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
 PE Title: Tactical Technology

Project Number: TT-05
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

Project

<u>Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
TT-05	Target Acquisition and Weapons Technology					
	25,870	19,738	22,700	19,566	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project develops sensors and processing for future tactical weapons, reconnaissance, and surveillance systems. Emphasis is on technology that can perform effective search and strike against existing and future targets, and provide flexible nonnuclear solutions for worldwide force projection in limited warfare and Third World conflicts. Concepts developed may be applied equally to find and attack fixed and mobile high value targets, as well as for peacetime treaty monitoring and verification.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Initial demonstration of multisensor autonomous target acquisition and smart search.
- Initiated development of a captive sensor/processor for cued search of hard to find targets.
- Demo of automatic tracking of tactical ballistic missile launchers.
- Demo of advanced uncooled infrared focal plane array.
- Demonstrated a moderate cost, infrared telescope and microlens array using binary optics.
- Demonstrated high performance Acoustic Charge Transport (ACT) signal micropocessor.

FY 1991 Planned Program:

- Integrate capability for tracking tactical ballistic missiles.
- Develop mature process for producing Acoustic Charge Transport (ACT) signal microprocessor.
- Development of IR microdetector array capable of 10x improvement in sensitivity.
- Measure targets using new, non-imaging IR sensor.

FY 1992 Planned Program:

- Evaluate advanced Auto Target Recognition (ATR) techniques.
- Demonstrate IR microdetector with linear array.
- Develop advanced signal processing for radar, EW, and communications applications.
- Complete expansions for worldwide Tactical Ballistic Missile tracking; transition to Army.
- Develop unattended ground sensors and on-site inspection aids for Treaty Monitoring and Verification.
- Initiate development of low cost guided, short range munition for use by manned aircraft and autonomous weapons.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-05
Budget Activity: 1. Technology Base

FY 1993 Planned Program:

- Design thermal imaging goggles with uncooled, high resolution IR array and holographic visor display.
- Design miniature synthetic aperture radar for use on short range unmanned air vehicles and missiles.
- Demonstrate rapid new target capability for smart weapons automatic target recognition.
- Demonstrate adaptive target fusion using neural networks to combine multi-sensor inputs.
- Demonstrate Multi-sensors for Treaty Monitoring and Verification.
- Develop seeker/sensor module with imaging and non-imaging IR.
- Demonstrate IR microdetector.

D. WORK PERFORMED BY: Martin Marietta, Orlando, FL; ERIM, Ann Arbor, MI; LTV, Dallas, TX; Lincoln Laboratories, Lexington, MA; Texas Instruments, Dallas, TX; and Westinghouse, Baltimore, MD.

E. RELATED ACTIVITIES: No: 0603226E, Project No. EE-30 (Weapon System Application Program) is an outgrowth of work in this project.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
 PE Title: Tactical Technology

Project Number: TT-06
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-06 Advanced Tactical Technology	13,075	14,851	12,000	15,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project is focused on the development of: (a) new compact, efficient, frequency-agile, diode-pumped, solid-state lasers for tactical applications; (b) tunable microwave source development for advanced surveillance application as well as for jamming of radar systems; and (c) an initiative in advanced military medicine with a focus on the prevention/treatment of infectious diseases of specific concern to the military Services.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Demonstrated orders of magnitude reduction in electronic burnout thresholds and upset levels with medium power microwave.
- Initiated program for high-efficiency/high average power, diode-pumped solid-state lasers for tactical applications.
- Initiated compact microwave source development.
- Initiated effect testing of a surrogate monopulse radar by a modulated microwave radiation source.

FY 1991 Planned Program:

- Demonstrate efficient coupling of diode pumps to solid-state laser materials for high peak power/high pulse repetition frequency (PRF) operation.
- Complete compact microwave source.
- Demonstrate immune response using ultrasonically emulsified immunomodulator.

FY 1992 Planned Program:

- Demonstrate laboratory breadboard operation of high average power diode-pumped solid state lasers.
- Characterize protective proteins (antigens).
- Prepare initial genetic deletions.

FY 1993 Planned Program:

- Demonstrate field transportable brassboard/lasers operating at high average power in the visible and mid-infrared spectral regions.
- Prepare initial recombinant vaccine.
- Evaluate immune response in phase I human trials.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06
Budget Activity: 1. Technology Base

D. WORK PERFORMED BY: Major performers include Hughes Aircraft Company, El Segundo, CA; Physics International, Oakland, CA; Science Research Laboratory, Somerville, MA; Georgetown University, Washington, DC; and Stanford University, Stanford, CA.

E. RELATED ACTIVITIES: Coordinated with Services' R&D programs to promote technology transfer and avoid duplication of effort.

F. OTHER APPROPRIATION FUNDS: None

G. INTERNATIONAL COOPERATIVE AGREEMENTS: DARPA is also an active participant in the US-UK Information Exchange Program on laser and microwave weapon technology and effects.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
 PE Title: Tactical Technology

Project Number: TT-07
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-07 Aeronautics Technology	10,666	26,522	8,200	10,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: As DoD attention swings sharply towards enhancing conventional defenses, the requirement to produce effective and affordable weapon systems becomes more and more important. The timely development of cost effective options and enabling technologies to satisfy this requirement is the objective of the Aeronautics Technology Project. The results of this project form the basis for future selection and development of affordable, conventional weapon systems that will greatly enhance our ability to perform both "battle management" and "battle execution" functions.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Completed flight test of a technology demonstration system for an air vehicle.
- Analyzed alternative active countermeasures techniques for air vehicles.
- Investigated very small jet engine technology for application to a variety of air missions.

FY 1991 Planned Program:

- Initiate flight test of developmental optical air data systems.
- Design, fabricate and rig test components for miniature low cost turbine engines.
- Develop and demonstrate technologies, concepts and concepts of operations using the principle of thrust vectoring.

FY 1992 Planned Program:

- Complete the optical air data system flight tests.
- Finalize designs of complete miniature turbine engines.
- Complete conceptual design studies of advanced internal combustion engines for application to high altitude airborne reconnaissance system.
- Initiate designs of vehicle incorporating SENGAP technology.
- Complete tests of a large integrated application of an advanced system.
- Design and test laboratory hardware for fuel cells with application to UAVs.

FY 1993 Planned Program:

- Completion of a design for a prototype advanced optical air data system.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-07
Budget Activity: 1. Technology Base

- Assemble, bench check and performance test miniature low cost turbine engines.
- Conduct bench tests of critical components for an advanced propulsion engine for airborne reconnaissance systems.

D. WORK PERFORMED BY: AeroVironment, Inc., Monrovia, CA; Institute for Defense Analyses, Alexandria, VA; Technology Research International, Callabassas, CA; Sunstrand Power Systems, San Diego, CA; Teledyne CAE, Toledo, OH.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602707E

Project Number: PB-01

PE Title: Particle Beam Technology

Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
PB-01 Particle Beam Technology	13,445	14,500	3,000	0	0	TBD

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The objective of this effort is to demonstrate the scientific feasibility of developing defensive weapons using high power electron beams. Such weapons would have the advantages of near speed-of-light delivery, very rapid retargeting, and deep target penetration resulting in destruction of targets with a variety of kill mechanisms. Potential applications include all-weather ship defense against advanced, highly mobile, non-nuclear missiles, defense of mobile ground vehicles against submunitions and land mines, and defense of fixed, hard site silos.

Most of the key propagation physics issues have already been demonstrated. In order to verify the energy scaling of propagation together with the feasibility of building a weapon within a size and weight of tactical interest, high energy compact accelerators must be developed. Two different accelerator concepts are being pursued with a down-selection in FY 1992. Compact accelerator technology spin-offs will be encouraged and supported.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Completed the fabrication and testing of the Spiral Line Induction Accelerator (SLIA) power supply.
- Prototype acceleration cell of SLIA was built and tested and the results were within 2% of the design goal.
- Mode structure of Beam Break Up Instability was measured. Damping techniques were demonstrated.
- Design completed for the 3.5 million electron volt, 10 kilo ampere (kA) SLIA injector.
- Completed transport experiment to verify transport theory for SLIA.
- Achieved 80% beam transport efficiency in one complete turn of the Recirculating Linear Accelerator (RLA).
- Completed RLA ion-focused regime erosion measurement.

FY 1991 Planned Program:

- Fabricate, assemble and test the first Spiral Line Induction Accelerator (SLIA) 1.5 million electron volt acceleration unit.
- Assemble and test the SLIA 3.5 MeV injector.
- Assemble the whole SLIA beamline and perform the one-turn, two-pass transport experiment.
- Determine transport efficiency in both spiral line and closed loop geometry for the Recirculating Linear Accelerator (RLA).

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602707E
PE Title: Particle Beam Technology

Project Number: PB-01
Budget Activity: 1. Technology Base

FY 1992 Planned Program:

- Fabricate and test the second 1.5 MeV acceleration unit.
- Integrate the injector, acceleration units and the transport line for SLIA.
- Accelerate the electron beam to 9.5 MeV.
- Perform RLA multi-turn experiment to achieve 9 MeV.

D. WORK PERFORMED BY: The major participants are: Sandia National Laboratories, Albuquerque, NM; Naval Research Laboratory, Washington, DC; Science Applications International Corporation, Palo Alto, CA; and Pulse Science, Inc., San Leandro, CA.

E. RELATED ACTIVITIES: In FY 1980 the Under Secretary of Defense for Research and Engineering approved the Particle Beam Technology Program which, beginning in FY 1981, consolidated the DoD charged particle beam efforts under the overall technical direction of DARPA. The Military Departments are responsible for advancing these technologies, which are essential in order to rapidly develop particle beam weapons once they are proven feasible.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Budget Activity: 1. Technology Base

PE Title: Integrated Command and
Control Technology

A. RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
IC-01	Distributed Information Systems 17,290	19,103	18,000	20,000	Continuing	Continuing
IC-02	Advanced Command, Control and Communications Technology 16,880	18,300	17,500	18,000	Continuing	Continuing
IC-03	High Definition Display Technology (HDDT) 20,000	74,500	0	0	0	94,500
TOTAL	54,170	111,903	35,500	38,000		

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This Program Element develops and demonstrates technology under Distributed Information Systems for building systems that can fulfill DoD needs for information processing DoD Command, Control and Communication Technology applications. In Advanced Command, Control and Communication Technology, development is aimed at secure, survivable, intelligent networks, utilizing advanced architectures and devices for controlling large-scale, high performance secure communication networks for world wide command and control. The High Definition Display Technology (HDDT) Project is dedicated to the development of technology and manufacturing capability for high definition displays to be used in military systems. This effort will establish a domestic technical capability and industrial base for the manufacturing of components necessary for military systems that capture, process, store, distribute and display high resolution images.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
 PE Title: Integrated Command and Control Technology

Project Number: IC-01
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
IC-01 Distributed Information Systems	17,290	19,103	18,000	20,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: Develop and demonstrate technology for building systems that can fulfill DoD needs for information processing in DoD Command, Control, and Communication (C³) applications. Development is aimed at distributed information systems that utilize advanced architectures and devices in large-scale, high-performance secure/survivable communications networks for worldwide command and control.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Transferred SIMNET technology to the Army.
- Demonstrated simulation interconnectivity between Battle Force In-Port Trainer (BFIT) and SIMNET via high performance wide-area Internet.
- Demonstrated Trusted Mach Prototype, a multi-level secure Unix-compatible operating system for C³ systems of the 1990s.
- Demonstrated working distributed data base systems in C³ testbeds.
- Developed distributed operating systems technology to support thousands of processors.
- Demonstrated a national file system technology base capable of supporting shared access to information by hundreds of sites on high performance networks.

FY 1991 Planned Program:

- Begin transition of the internet to support Open Systems Interconnection (OSI) standard protocols.
- Demonstrate techniques for providing real-time data communication to support distributed command and control applications in an internet environment.
- Develop mechanisms that permit integrated operation of very large distributed systems with thousands of nodes, using a design approach where the distributed nature of the system is transparent to the user.
- Develop mechanisms to support software maintenance for distributed systems in transparent mode.
- Develop executing prototypes of domain specific application interface definitions to ensure software interoperability.
- Develop techniques to exploit multicomputers for C³ and scientific computation.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-01

PE Title: Integrated Command and
Control Technology

Budget Activity: 1. Technology Base

FY 1992 Planned Program:

- Design application domain-specific interface definitions for software interoperability.
- Expand national file system data distribution technology to all major Internet back-bone sites.
- Demonstrate network-based software management over the Defense Research Internet (using National File Server).
- Select and plan a military application to demonstrate an integrated distributed systems technology base.
- Demonstrate/distributed/replicated file systems to ensure file survivability across communications outages.

FY 1993 Planned Program:

- Develop initial executing examples of domain-specific application interface definitions for software interoperability.
- Transfer national file system technology to a self-sustaining industrial base.
- Demonstrate close integration of object oriented data base and programming language technologies.
- Design military application of very large distributed systems technology base.
- Expand network-based software management to all major Internet back-bone sites.

D. WORK PERFORMED BY: University of Southern California/Information Sciences Institute, Marina del Rey, CA; Bolt, Beranek and Newman, Cambridge, MA; Carnegie-Mellon University, Pittsburgh, PA; University of California, Los Angeles, CA; and Cornell University, Ithaca, NY.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-02

PE Title: Integrated Command and Control Technology

Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
IC-02 Advanced Command, Control and Communications Technology	16,880	18,300	17,500	18,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project develops and demonstrates technology for secure, survivable networks, utilizing advanced architectures and devices for world-wide command and control.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Began development of third-generation tactical packet system prototype with megabit burst data rates.
- Demonstrated multimedia interfaces in strategic C³ testbed.
- Transitioned stable portion of high-speed Internet testbed to operation as DARPA-wide research infrastructure.
- Completed two gigabit/second testbed networks.

FY 1991 Planned Program:

- A compatible set of advanced C³ technologies suited for defense requirements of the 21st century will be demonstrated in integrated multi-service, multi-echelon testbeds combining simulation with actual combat forces.
- Demonstrate integrated security device in tactical packet system.
- Demonstration of a digital packet network switch capable of performing policy routing (examining contents and enforcing pre-established communications policies), expandable to data rates of 45 megabits per second.
- Internet research testbed will support 10 sites for experiments with policy routing, fair queueing and connection-oriented packet communications.
- Command and control experimental environment will span Europe and CONUS at megabit data rates.
- Demonstrate Packet radio as reliable technology for digital and non-real time voice communication.
- Develop an artificial neural network (ANN) prototype control system.

FY 1992 Planned Program:

- Develop five gigabit/second testbed networks which will support tens of sites using several different switching technologies.
- Preliminary standards for policy routing will be established in the Internet.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-02

PE Title: Integrated Command and
Control Technology

Budget Activity: 1. Technology Base

- Demonstrate integrated multimedia tactical packet node based on high-density computing technology.
- Demonstrate encrypted mail as technology to support C³ and DoD business transitions.

FY 1993 Planned Program:

- An architecture for a nationwide gigabit/second testbed will be defined.
- Policy routing standards will be established in the operational Internet.
- Demonstration of near-gigabit/second satellite links in conjunction with terrestrial networks.
- A tactical testbed will employ multiple media and high-density switching with survivable protocols at megabit/second rates, interconnected with the Wide-Area Internet.

D. WORK PERFORMED BY: University of Southern California/ Information Sciences Institute, Marina del Ray, CA; Bolt, Beranek and Newman, Cambridge, MA; SRI International, Menlo Park, CA; NYSERNET, Inc., Troy, NY; Harris Corporation, Melbourne, FL; Rockwell-Collins, Dallas, TX; and AT&T Labs, Whippany, NJ.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Budget Activity: 1. Technology Base

PE Title: Materials/Electronics Technology

A. RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
MPT-01 Materials Processing	15,762	55,837	29,836	18,500	Continuing	Continuing
MPT-02 Electronics Processing	14,473	19,171	16,536	15,000	Continuing	Continuing
MPT-03 Optoelectronics/GaAs	0	10,298	15,664	15,000	Continuing	Continuing
MPT-04 X-Ray Lithography	30,000	60,100	0	0	0	90,100
MPT-05 IR Crystal Growth Technology	0	10,000	0	0	0	10,000
TOTAL	60,235	155,406	62,036	48,500		

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The objective of these projects is to develop technology related to those materials and devices that make possible a wide range of new military capabilities. The Materials Processing project (MPT-01) focuses on the development of novel materials and processing routes to demonstrate advanced composites; strong, stiff ceramic fibers; applications of artificial intelligence and sensors to materials processing; development of metal matrix composite materials for advanced aerospace structures; and research on diamond films for thermal management in electronic packaging. The FY 1991 and FY 1992 increase is being applied towards work in Fiber Metal Matrix. The Electronics Processing (MPT-02) goal is to develop and implement next-generation electronic devices, circuits, and systems manufacturing for military use including development of maskless processing for submicron structures, and advanced semiconductor manufacturing and applications. Under the Optoelectronics/GaAs project (MPT-03) an Optoelectronics Center including comprehensive programs in optoelectronics and photonics was initiated in FY 1989 to address the military needs in this area. The project includes advanced components development and applications of quantum-well devices to circuits. X-ray lithography for defining semiconductor structures with 0.25 micrometers or better resolution is being developed under MPT-04. All aspects of X-ray Lithography (sources, masks, aligners, and device fabrication) are being addressed. IR Crystal Growth Technology (MPT-05) is funded only in FY 1991.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E Project Number: MPT-01
 PE Title: Materials/Electronics Technology Budget Activity: 1. Technology Base

A. RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
MPT-01 Materials Processing	15,762	55,837	29,836	18,500	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The major goal of this project is to develop novel materials and processing routes for production of advanced high temperature, structural composites with improved performance at lower manufacturing costs. A major area of concentration is the application of process modeling, sensors, and expert systems to materials manufacturing. Other areas emphasized are: research into metal matrix composites as advanced aerospace structural materials to upgrade gas turbine engines and airframe components; and synthesis of diamond films for thermal management in electronic packaging.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Demonstrated oxidation resistant alloying and coating which allow niobium alloys to be used up to 1400°C.
- Demonstrated synthesis of ceramic composites by pyrolysis of a polymer precursor matrix.
- Demonstrated sensor viability and process model adequacy for powder consolidation by intelligent hot isostatic pressing.
- Established a model metal matrix composite program to ultimately produce composites for aerospace applications.
- Initiated program on synthesis of diamond films for thermal management in electronic packaging.

FY 1991 Planned Program:

- Initiate evaluation of ceramic composite components for use in a gas turbine engine.
- Experimentally demonstrate theoretical predictions of vapor phase transport to coat carbon-carbon composites for oxidation protection.
- Develop microfabrication technology incorporating advanced growth techniques such as molecular beam epitaxy and metal organic chemical vapor deposition, and advanced processing techniques such as reactive ion beam etching and impurity induced intermixing.
- Demonstrate cost-effective manufacturing technology to produce 1-inch wide, continuous fiber, metal matrix composite monotape.
- Initiate ceramic insertion program to enhance performance of weapons system which require improved advanced structural materials.
- Initiate consortium to manufacture strong, stiff multifilament ceramic fibers.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-01

PE Title: Materials/Electronics Technology

Budget Activity: 1. Technology Base

FY 1992 Planned Program:

- Demonstrate diamond film growth rates of greater than 150 microns per hour over 10 centimeter diameter area in a system which incorporates intelligent process control.
- Evaluate ceramic composites supplied by various manufacturers for extended component evaluation in a gas turbine environment.
- Demonstrate room temperature and elevated temperature mechanical behavior of extremely lightweight intermetallic compound.
- Demonstrate hot isostatic pressing schedule to achieve full consolidation of 50% fiber volume composite specimens and demonstrate feasibility of roll bonding consolidation technique for composite sheets.

FY 1993 Planned Program:

- Demonstrate thermal management capability of high conductivity diamond films in an electronic device.
- Demonstrate improved motor performance due to utilization of ceramic bearings to replace steel bearings.
- Evaluate strength and stiffness of high temperature ceramic fibers for composite reinforcement.

D. WORK PERFORMED BY: Major performers are: United Technologies Research Center, East Hartford, CT; General Electric Corporation, Schenectady, NY; University of Virginia, Charlottesville, VA; Sandia Laboratories, Livermore, CA; Norton Co., Northboro, MA; Williams International, Wald Lake, MI; and 3M Corporation, St. Paul, MN.

E. RELATED ACTIVITIES: DARPA's research on Materials Processing is coordinated within the Department of Defense (DoD) and with other federal agencies via the National Science Foundation-hosted Interagency Materials Group, Office of Science and Technology Policy Committee on Material, and various Director Defense Research and Engineering (DDR&E) sponsored topical workshops on structural materials and materials processing. These activities assure that no unnecessary duplication of effort occurs.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-02

PE Title: Materials/Electronic Technology

Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MPT-02 Electronics Processing	14,473	19,171	16,536	15,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project comprises development and implementation of future generation electronic and opto-electronic devices, materials, and circuits. The emphasis in this project is on the development of advanced semiconductor processing equipment designed to reduce the cost of a wafer manufacturing facility by an order of magnitude, and the fabrication of advanced biosensors for broad-based chemical and biological warfare (CBW) defense and intelligence collection.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Realized a 4-kilobit ferroelectric memory structure.
- Millimeter wave power generation up to 700 gigahertz from resonant double barrier tunneling diodes.
- Demonstrated a first ever, three terminal quantum well device, the Quantum Excited State Tunneling Transistor.

FY 1991 Planned Program:

- Demonstrate the capability to conduct all necessary semiconductor fabrication steps in individual ultraclean modules rather than large clean rooms.
- Conduct 4,000-gate-complexity manufacturing demonstrations using ultraclean modules.
- Fabricate integrated optoelectronic circuit for optical interconnects.
- Achieve 0.35-micron lithography in the Microelectronics Manufacturing Science and Technology (MMST) effort.
- Complete unit testing of initial MMST object-oriented computer-integrated manufacturing (CIM) software.
- Demonstrate light weight/low cost material for absorbing electromagnetic energy.
- Develop mature process for producing Acoustic Charge Transport (ACT) signal microprocessor.

FY 1992 Planned Program:

- Fabricate quantum well lasers (lattice matched and strained layers) for high operating temperatures.
- Release the second version of the Microelectronics Manufacturing Science and Technology (MMST) object-oriented computer-integrated manufacturing (CIM) software.
- Demonstrate two Modular Processing Systems with five process modules capable of performing at low cost, fabrication steps of low volume, state-of-the-art integrated circuits.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 40602712E

Project Number: MPT-02

PE Title: Materials/Electronic Technology

Budget Activity: 1. Technology Base

- Demonstrate closed-loop control of all MMST processes.
- Initiate efforts to develop high-speed, low-power analog-to-digital converters (ADCs), digital-to-analog converters, and multiplexers for advanced military signal processing needs.
- Show biosensor signal gain and thru-chip fluidics.

FY 1993 Planned Program:

- Demonstrate MMST fabrication cycle-time and yield with a 1,000-wafer test.
- Demonstrate MMST fabrication flexibility by processing two distinct process flows.
- Demonstrate MMST fab capability to fabricate an externally designed circuit.
- Demonstrate analog multiplexers for wide-dynamic range signals to significantly reduce the power consumed in processing sensor data.
- Demonstrate heterojunction bipolar transistor (HBT) ADCs for ultra-high-speed conversion of microwave signals to digital form for advanced signal processing.
- Demonstrate biosensor metabolic imaging and on-chip controlling electrode.

D. WORK PERFORMED BY: Texas Instruments, Dallas, TX; Stanford University, Palo Alto, CA; and Molecular Devices, Menlo Park, CA.

E. RELATED ACTIVITIES: The work is coordinated with Service research efforts through the Advisory Group on Electron Devices and via annual government-wide program reviews. These activities assure that no unnecessary duplication of effort occurs. The MMST contract is a cost-shared effort between DARPA and the Air Force.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-03

PE Title: Materials/Electronic Technology

Budget Activity: 1. Technology Base

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MPT-03 Optoelectronics/Gallium Arsenide (GaAs)	0	10,298	15,664	15,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project is to develop next-generation and future generation electronic and opto-electronic devices and circuits for military use. Emphasized are: non-volatile ferroelectric memory technology, advanced semiconductor processing, and optoelectronics. The efforts in FY 1991 and beyond were previously part of project MPT-02.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Indium gallium aluminum arsenide (InGaAlAs) layers of excellent morphology were grown on Indium phosphide (InP) by molecular beam epitaxy.
- Demonstrated high-speed optically addressed spatial light modulator.
- High electron mobility transistors were fabricated and tested up to 105 gigahertz (GHz).

FY 1991 Planned Program:

- Demonstrate Integrated Circuit (IC) fabrication based on limited reaction processing.
- Complete one-dimensional process modeling for GaAs heterostructures.
- Demonstrate optically controlled phased array subsystem.
- Develop high performance vertical cavity surface emitting lasers.

FY 1992 Planned Program:

- Demonstrate non-destructively read non-volatile ferroelectric memory cells.
- Develop smart special light modulators for applications in optical instrument and image processing.
- Fabricate acousto-optic, 2 gigahertz (GHz) spectrum channelizer for field test.
- Fabricate optical associative memory module for field test in data base management.
- Demonstrate optical, binary, phase only, matched filter any module for pattern recognition.

FY 1993 Planned Program:

- Develop a 64-kilobit ferroelectric non-volatile memory that will reduce cost of such memory 1000x.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-03

PE Title: Materials/Electronic Technology

Budget Activity: 1. Technology Base

- Develop ferroelectric capacitors for extremely long lifetime non-volatile memories.
- Develop accelerated lifetime tests for ferroelectric memories.
- Demonstrate real time, compact synthetic aperture radar (SAR) with spot light mode.
- Demonstrate steering of wide-band radar beam with optical control module.

D. WORK PERFORMED BY: Stanford University, Palo Alto, CA; Texas Instruments, Incorporated, Dallas, TX; McDonnell Douglas Electronics Systems Company, Huntington Beach, CA; Westinghouse, Baltimore, MD; Pennsylvania State University, University Park, PA; North Carolina State University, Raleigh, NC; National Center for Integrated Photonics Technology (NCIPT); Optoelectronic Technology Center (OTC); Optoelectronic Materials Center (OMC); Martin Marietta, Denver, CO; Harris, Melbourne, FL; Texas Instruments, Dallas, TX; ERIM, Ann Arbor, MI; General Electric, Syracuse, NY; Dynetics, Huntsville, AL; Hughes, Malibu, CA; BDM, Fairfax, VA.

E. RELATED ACTIVITIES: Efforts in this project are coupled to the Services' programs through use of service agents, annual DoD-wide program reviews, and coordination through the Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of efforts occur.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

FY 1991 AMENDED RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0602714E
 PE Title: Defense Research Sciences

Project Number: NM-01
 Budget Activity: 1. Technology Base

A. RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
NM-01 Nuclear Monitoring	34,437	26,692	19,800	17,930	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This multifaceted program conducts research for verification of nuclear testing treaties. Research is conducted to enhance U.S. capabilities for monitoring worldwide nuclear explosions and provide technical support for U.S. participation in both bilateral and multilateral fora. This program also focuses research on methods for accurately detecting and characterizing radiation from nuclear sources. Better technical understanding is required to assess the value of the data from nuclear explosions and to support international cooperative verification activities and to incorporate the results from these activities into existing monitoring systems. This research program provides the required technical support to U.S. efforts in the Conference on Disarmament for the development and testing of an International Seismic Data Exchange System.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Improved advanced methods of yield estimation were tested and applied over a range of yields incorporating new data. Technical support to ongoing nuclear testing negotiations was provided.
- The prototype intelligent array processing system was tested and evaluated. This facility will be used for receipt and processing of advanced monitoring stations which are prototypes for future monitoring systems. High performance stations were developed for installation within the USSR under the cooperative Eurasian Seismic Studies Program.
- Installation of a high-frequency array in the Federal Republic of Germany (FRG), in cooperation with the FRG, was completed.
- Methods for deriving geophysical conditions at test sites from new digital space surveillance data were examined.
- Completed final planning of the large-scale global test of the international monitoring system and tested critical elements of this worldwide system. Support provided for additional participants.
- Nuclear materials detectors tested against specific nuclear sources under realistic operating conditions.

FY 1991 AMENDED RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0602714E
PE Title: Defense Research Sciences

Project Number: NM-01
Budget Activity: 1. Technology Base

FY 1991 Planned Program:

- The advanced signal processing system, including yield determination, will undergo testing and evaluation. Data from the international cooperative programs, including the US-Eurasian Seismic Studies program, will be incorporated into the system.
- A large-scale test of a global monitoring system will be carried out under auspices of the Conference on Disarmament involving the U.S. International Data Center.
- Technical support will be provided to nuclear testing negotiations.
- New methodologies for analysis of on-site measurements will be tested for yield determination using data collected under new treaty protocols.
- Transfer Advanced Seismic Stations to Defense On-Site Inspection Agency (OSIA) for use in the Soviet Union.

FY 1992 Planned Program:

- Demonstration of prototype Intelligent Monitoring System incorporating Eurasian Seismic monitoring data and other stations in the Soviet Union and China.
- Initiation of new cooperative international programs for collection and analysis of data from small events in Eurasia.
- Completion and demonstration of on-site verification technologies, including new systems to analyze data provided by OSIA.
- Technical support will be provided to nuclear testing negotiations, including the Conference on Disarmament.
- Complete and transfer the multispectral surveillance program.

FY 1993 Planned Program:

- Begin the transfer of the technology of high frequency seismic arrays and Intelligent Monitoring data processing system to the Air Force and incorporate this system into the U.S. Atomic Energy Detection System.
- Transfer the technology from yield estimation program to the Air Force.
- Test and evaluate the Signal Detection and Analysis System.

D. WORK PERFORMED BY: Approximately 66% of this work is performed by industrial contractors, 10% in-house laboratories, 7% foreign, and 17% university. Major performers include: Teledyne Geotech, Garland, TX; Science Applications International Corporation, San Diego, CA; University of Florida, Gainesville, FL; Southern Methodist University, Dallas, TX; Lincoln Laboratory, Cambridge, MA; California Institute of Technology, Pasadena, CA; St. Louis University, St. Louis, MO; Columbia University, New York, NY.

FY 1991 AMENDED RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0602714E

Project Number: NM-01

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

E. RELATED ACTIVITIES: Complementary research is conducted by the National Laboratories of the Department of Energy and by the Air Force Technical Applications Center (AFTAC) for operational applications. These efforts are coordinated through existing interagency agreements and periodic working level coordination meetings. No duplication of effort is conducted.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Agreements with Norway, the Federal Republic of Germany and China call for joint activities in seismic facilities in those countries. The United Nations' Conference on Disarmament, with U.S. concurrence, has formally agreed on the large-scale global test of the international monitoring system in FY 1991-1992.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 PE Title: Experimental Evaluation of
Innovative Technologies

Budget Activity: 2. Advanced Technology
Development

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
EE-21 Close Combat	32,167	35,111	31,000	27,000	Continuing	Continuing
EE-23 Enhanced Fighter Maneuverability	16,902	11,000	5,800	2,000	0	82,450
EE-24 Advanced Short Takeoff Vertical Landing	1,000	0	0	0	0	15,000
EE-25 Tactical Airborne Laser	22,000	0	0	0	0	66,942
EE-26 Hypersonic Weapons Technology	13,555	1,049	0	0	0	62,117
EE-27 Advanced Satellite Technology Program	25,000	34,992	29,000	35,000	Continuing	Continuing
EE-30 Smart Weapons Application Program	208	10,500	27,000	11,000	Continuing	Continuing
EE-34 Guidance Technology	5,500	6,360	9,100	10,000	Continuing	Continuing
EE-36 Advanced ASW Technology	0	9,500	25,000	25,000	Continuing	Continuing
EE-37 Advanced Simulation	0	8,734	20,800	10,000	Continuing	Continuing
EE-38 Advanced Undersea Systems	(83,685) ²	(75,000) ²	30,000	40,000	Continuing	Continuing
EE-39 Unmanned Undersea Vehicle Systems	0	0	20,000	20,000	Continuing	Continuing
Total ¹	160,505	178,191	289,700	265,683		

¹Total includes classified projects not identified herein.

²Funded in PE 0603569E Advanced Submarine Technology.

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This program element is dedicated to the demonstration and evaluation of advanced research and development concepts. Individuals project descriptions are with each project.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-21
 Budget Activity: 1. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Close Combat

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
Close Combat						
EE-21	32,167	35,111	31,000	27,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project is in a state of transition reflecting the changed needs of the Department of Defense. Funding for FY 1990 and some of FY 1991 was for completion of projects begun under the joint armor/anti-armor (AAA) program. This included protection systems and chemical energy (CE)/kinetic energy (KE) penetrators. Although DARPA will retain management of the program beyond FY91, virtually all funding will be provided by the Army and USMC. The new project focus is on the application and testing of lightweight, deployable close combat technologies. Current program emphasis includes special enhanced survivability and lethality technologies, development of smart wide area mines, mine detection systems, guided weapons and fire control, advanced command and control for contingency operations.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Development of advanced CE warheads, armor protection, and continued transition of products to the Services.
- Tests were successfully passed by DARPA/AAA armor contractors.
- Demonstrated innovative "velcro-like" ceramic armor attachment technique for lightweight application.
- Began development of hand-held mine detection systems.
- Built fire control data base for anti-helicopter mine.

FY 1991 Planned Program:

- Initiate testing of hand-held mine detection systems.
- Integrate and test advanced tandem warheads.
- Initiate work on improved target acquisition/fire control technologies for mines.
- Complete evaluation of sensor and algorithms for smart weapons.
- Competitive testing of brassboard anti-helicopter mine systems; downselect/initiate prototypes.
- Perform final demonstration of warhead/penetrators for phase II and begin transition to Services.
- Demonstrate various optimized light applique armors.

FY 1992 Planned Program:

- Continue development and testing of advanced smart anti-helo mine system.
- Complete development and demonstration of advanced armor as part of Nunn Cooperative Program with Germany.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-21
Budget Activity: 1. Advanced
Technology Development

- Deploy testbed for advanced tactical command and control technology for contingency operations.
- Final test of hand-held mine detection prototype.

FY 1993 Planned Program:

- Complete testing of anti-helicopter mine prototype systems and transition to Army.
- Demonstrate improved target acquisition/fire control systems for mines.

Program To Completion:

- Define, develop and test concepts for autonomous weapons in 21st Century battlefield environment.
- Integrate and demo decision support tools in command and control testbed for contingency operations.
- Demo advanced prototype command and control functionality in an integrated testbed environment.

D. WORK PERFORMED BY: The major performers are Los Alamos National Lab, Los Alamos, NM; Battelle, Columbus, OH; Lawrence Livermore National Lab, Livermore, CA; FMC, San Jose, CA; University of Texas, Austin, TX; Texas Instruments, Dallas, TX; General Motors Military Vehicle, Indianapolis, IN; and General Dynamics, Warren, MI.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Funding for joint armor/anti-armor program virtually eliminated. Contingency command and control added.

F. PROGRAM DOCUMENTATION: None.

G. RELATED ACTIVITIES: This program has been coordinated with the Army and Marine Corps to ensure there are no duplication of effort.

- U.S. Army PE 0602618A, Project AH81.
- Marine Corps PE 0603635N. DARPA PE 0602702E/TT-04 related technology project.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Four cooperative armor/anti-armor international programs with the United Kingdom, Germany, and France will be completed in FY91 and FY92.

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
3Q/FY91	Complete anti-helicopter and command and control brassbroad mine tests.
4Q/FY91	Complete demonstration of Light Applique Systems Techniques (LAST) Armor.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-21

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 1. Advanced
Technology Development

3Q/FY92 Complete test of hand held mine detector system.
4Q/FY92 Complete joint cooperative program with Germany, France and
UK.
2Q/FY93 Deploy contingency operations command and control testbed.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experience Evaluation of
Major Innovative Technologies

Project Number: EE-23

Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
Enhanced Fighter Maneuverability (X-31)						
EE-23	16,902	11,000	5,800	2,000	0	75,786

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The Enhanced Fighter Maneuverability (EFM) program will integrate and demonstrate a number of emerging technologies that collectively have the potential to significantly increase fighter aircraft agility and to improve close-in combat (CIC) exchange ratios. The technical challenge is to produce a low-cost flight vehicle that will demonstrate the payoff of high agility at high angles of attack, using thrust vectoring, integrated flight and propulsion control systems, and tailored configuration design. Two flight demonstrator aircraft will produce data on the technical and military implications of post-stall maneuvers for close-in aerial combat. These results will provide critical design and performance data for assessing the utility and cost benefit of the EFM technology as applied to retrofitting existing fighter aircraft and for integration into future fighter aircraft.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Completed assembly of X-31 No. 1 and No. 2.
- Completed No. 1 aircraft checkout for flight testing.

FY 1991 Planned Program:

- Complete airworthiness flights of both aircraft.
- Initiate conventional envelope expansion flights.
- Initial government pilot evaluation flights.

FY 1992 Planned Program:

- Initial post-stall (PST) maneuvering flights.
- Initial Air Force and Navy utility evaluations.

FY 1993 Planned Program:

- Documentation of flight test results and transition to Services for evaluation.

D. WORK PERFORMED BY: Rockwell International Corporation, Los Angeles, CA; Naval Air Systems Command, Arlington, VA; and NASA Langley Research Center, Hampton, VA.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-23

PE Title: Experience Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

E. RELATED ACTIVITIES:

- A U.S. Government Agility Steering Group has been established among DARPA, NASA, the Navy, and the Air Force to coordinate high angle of attack research with other flight test programs.
- The X-29 High Angle of Attack Program will complement X-31 data and contribute to the technology base vital for application of EFM concepts.
- The Navy and Air Force are requesting funds in FY 1992 and FY 1993 to participate in a DARPA-led X-31 EFM technology evaluation with the German government. Data generated during this program will help establish the design requirements data base for applications of integrated controls to future fighter aircraft. (Navy - PE0603231N - Navy Advanced Tactical Fighter/Next Generation Fighter; USAF-PE06032451F - Advanced Fighter Technology Integration). This effort does not duplicate any other known program within the Department of Defense.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: The X-31 Enhanced Fighter Maneuverability program is a joint program with the Federal Republic of Germany that was initiated under the provisions of the Nunn-Quayle NATO Cooperative Research and Development Initiative. The program operates under a Memorandum of Agreement between DARPA and the German Federal Ministry of Defense. Messerschmitt-Bolkow-Blohm, as the German prime contractor, is tasked with development of the flight control system requirements, as well as design and fabrication of the wing and thrust vector vanes. The X-31 program was initiated in 1986. This cooperative program is transferring significant technical data on post-stall maneuver and flight control to the U.S. industrial technology base.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-27

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Advanced Satellite Technology (LIGHTSAT)

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
LIGHTSAT						
EE-27	25,000	34,992	29,000	35,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The Advanced Space Technology Program (ASTP) is a multi-disciplinary technology development aimed at enhancing the access to space and reducing the cost of space systems. The ASTP has four components: development of enabling technologies, sponsorship of the initial launches of the Pegasus Air Launch Vehicle (ALV), development and demonstration of a Standard Small Launch Vehicle (TAURUS), and launch of experimental lightweight satellites (LIGHTSAT).

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Launched and evaluated first Pegasus.
- Launched and evaluated two MACSAT communication satellites.
- Awarded contracts for 28 technology developments for satellite systems, subsystems, and components.
- MACSAT satellites utilized to support Desert Shield.

FY 1991 Planned Program:

- Launch second Pegasus with seven MICROSAT Communications Satellites.
- Evaluate MICROSAT Communications Satellites.
- Transition Pegasus Air Launch Vehicle to USAF.
- Conduct tactical demonstrations of MACSAT and MICROSATS in cooperation with the military services and U.S. Space Command.
- Transition MACSATs to users.

FY 1992 Planned Program:

- Continue technology developments initiated in FY 1990 and FY 1991.
- Develop concepts and technologies for networking of existing and future satellite systems to maximize utilization of data collection and dissemination and to provide robust and proliferated satellite control functions means.
- Continue EHF communications technologies development and initiate integration as to a system level technology demonstration payload.
- Launch first TAURUS Launch Vehicle and classified satellite.
- Transition MICROSATS to users.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-27

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

FY 1993 Planned Program:

- Continue technology developments initiated in prior years.
- Continue system level integrated technology demonstration project incorporating technologies from earlier program efforts.
- Transition the TAURUS standard small launch vehicle to the Air Force.
- Transition technologies to services.

Program to Completion: This is a continuing program.

D. WORK PERFORMED BY: Orbital Sciences Corporation, Chandler, AZ; Defense Systems, Inc., McLean, VA; Space Applications Corporation, Fairfax, VA; Lincoln Laboratories, Lexington, MA; Hughes Aerospace, Los Angeles, CA; SAIC, San Diego, CA; Ball Aerospace, Boulder, CO.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: The increase in FY 1991 is necessary to minimize the impact of the \$10 million reduction in FY 1990 necessitated by the rescission authorized by the FY 1990 Supplemental Appropriation Act.

F. PROGRAM DOCUMENTATION:

- USAF/DARPA MOA dated 14 November 1988.
- U.S. Navy/DARPA MOA dated 13 December 1988.
- NASA(DRYEN)/DARPA MOA dated 1988.
- NASA (GODDARD)/DARPA MOA dated 1989.
- U.S. Army MOA dated 1990.
- SDIO/DARPA MOA dated 1990.

G. RELATED ACTIVITIES:

- DARPA MOA's with Army, Navy and Air Force.
- Navy launched two DARPA UHF Satellites on a SCOUT vehicle.
- First TAURUS demonstration launch will include a satellite payload developed by the Air Force.
- Maintain close coordination with Military Services to eliminate unnecessary duplication.

H. OTHER APPROPRIATION FUNDS: NONE.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: NONE.

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Oct 90	Complete BAA awards for technology development.
Apr 90	Launch/evaluation of air launched vehicle.
May 90	Launch of two UHF satellites.
Jul 90	Initiate demonstration of Multiple Access Communication Satellite.
Aug 90	Provided MACSAT support to Desert Shield.
Summer 91	2nd Pegasus launch (and orbit of MICROSATS).

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-27

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Fall 91 Initiate demonstration of MICROSATs.
1991-1993 Numerous technology development completions.
Spring 92 RFPs for integrated technology demonstration.
Fall 92 First launch of TAURUS (SSLV)/DARPA satellite.
Fall 92 Award contracts for integrated technology demonstration.
Late 92 Initiate demonstration of DARPA classified satellite.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-30
 PE Title: Experimental Evaluation of Budget Activity: 2. Advanced Technology
Major Innovative Technologies Development

A. RESOURCES: (\$ In Thousands)

Project Title: Smart Weapons Application Program

Popular

<u>Name</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
Thirsty Saber						
EE-30	208	10,500	27,000	11,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This joint DARPA/Army project demonstrates autonomous weapons concepts that will provide flexible worldwide non-nuclear force projection options to attack critical tactical targets such as tactical ballistic missiles, mobile air defense or command and control units, including those that employ camouflage, concealment, and deception techniques.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Began design of multi-sensor system hardware.
- Prepared demo test plan.
- Completed Memorandum of Understanding (MOU) with Army.

FY 1991 Planned Program:

- Begin fabrication and integration of demonstration system.
- Complete evaluation of brassboard design for integration onto airframe.
- Demonstrate high rate smart search algorithms.

FY 1992 Planned Program:

- Design munition for use from airframe dispense system.
- Complete hardware-in-loop simulation of automatic target recognition unit.

FY 1993 Planned Program:

- Complete system integration for demo.
- Initiate Joint DARPA/ARMY flight test program.
- Complete Army and other Service requirements analysis.

Program To Completion:

- Complete flight test program.
- Demonstrate real-time, multi-sensor, automatic target recognition.
- Transition to Army and other Services full-scale development.

D. WORK PERFORMED BY: Martin Marietta, Orlando, FL; General Dynamics, San Diego, CA; Texas Instruments, Dallas, TX; Science Applications, Inc., Arlington, VA; Lincoln Labs, Lexington, MA.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-30

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced Technology
Development

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Funding has changed due to consolidation from TT-05 and EE-21 into EE-30. Previous summary had funding distributed between both PEs.

F. PROGRAM DOCUMENTATION: DARPA/ARMY MOA (Classified) dated 13 July 1990.

G. RELATED ACTIVITIES:

- Program Element 0602702E/TT-05 Target Acquisition and Weapons Technology has related work in FY92 and beyond.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
3QFY90	Project contract award
4QFY90	MOU with Army
2QFY91	Preliminary Design Review
1QFY92	Critical Design Review
2QFY93	First Test Flight
2QFY94	Complete Flight Test

FY 1992/FY1993 AMENDED RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-34
 Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
EE-34	Guidance Technology 5,500	6,360	9,100	10,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: Fire-and-forget stand-off weapons require high-precision navigation capabilities and robust Electronic Support Measurement (ESM) systems to effectively eliminate prime targets with minimal collateral damage in the target area and minimal risk to the launch platform. This program develops the high-accuracy, low-cost navigation and ESM subsystems technologies required for both the next generation stand-off weapons, as well as for upgrading current weapon inventories. Potential programs that could be impacted include the Advanced Interdiction Weapon Systems (AIWS), AGM-130, the Tomahawk Land Attack Missile (TLAM-conventional), and unmanned, long-endurance airborne battle-field support vehicles. Air defense suppression technology upgrades, in lieu of TACIT RAINBOW, will also employ these capabilities. Specific research areas include the following: (1) Advanced all solid-state, low-cost navigation-grade solid-state miniature inertial measurement unit (MIMU) systems; (2) multi-channel-on-a-chip, high dynamics, miniature Global Positioning System (GPS) receivers (MGRs); (3) develop high-precision (0.001 degrees/hour), low-cost navigation-grade MGR/MIMU system, called the GPS Guidance Package (GGP Phase 1); (4) Upgrade GGP to a 0.003 deg/hr capability (GGP Phase 2); (5) miniaturized, highly-parallel, Gallium Arsenide (GaAs) Monolithic Microwave Integrated Circuit (MMIC)-based Smart Electronic Warfare receivers-on-a-chip; and (6) Battlefield mapping and registration-support packages based on (1), (2) and (3).

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Developed advanced Broadband Fiber Source supplying enough optical input to run three fiber-optic gyroscopes simultaneously.
- Fabricated multi-channel-on-a-chip MGR correlator and placed frequency synthesizer circuit on GaAs MMIC Radio Frequency front-end chip.
- Developed navigation-grade interferometric fiber-optic gyro breadboard.

FY 1991 Planned Program:

- Both contractors will develop their demonstration GPS based Guidance Package (GGP) with the miniature GPS receiver (MGR) and miniature inertial measurement unit (MIMU) subsystem breadboard

FY 1992/FY1993 AMENDED RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-34
Budget Activity: 2. Advanced
Technology Development

including the Interferometric Fiber Optic Gyro (IFOG) and validate the GGP performance.

- Conduct lifetime tests of IFOG pump-sources.
- Evaluate and characterize performance of IFOG integrated optical circuit components.

FY 1992 Planned Program:

- Begin development of a flyable navigation brassboard.
- Develop MMIC/Very High Speed Integrated Circuit-based, miniature emitter-location receiver technology.
- Acquire testbed laboratory for subsystem evaluation.

FY 1993 Planned Program:

- Complete GGP Phase 1.
- Begin GGP Phase 2.

D. WORK PERFORMED BY: The Naval Ocean Systems Center, Litton Industries, Texas Instruments, Honeywell and Rockwell International/Collins Division.

E. RELATED ACTIVITIES: None.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-36
 Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Advanced ASW Technology

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
Advanced ASW Technology						
EE-36	0	9,500	25,000	25,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project is developing and demonstrating systems that will significantly improve our Anti-Submarine Warfare (ASW) capabilities. One activity will demonstrate autonomous localization of a submarine target using low frequency active sonar. The program will pursue the signal processing and control aspects that will provide application to manned aircraft as well as unmanned airborne vehicles. A second activity will develop an automated sonar test bed that will improve ASW surveillance tracking and reduce crew size. A third activity will demonstrate an ASW Battle Management Prototype that will address low frequency active sonar issues of interoperability and Acoustic Warfare (AcW).

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments: Not Applicable.

FY 1991 Planned Program:

- Complete conceptual design for Automated Targeting And Relocation System (ATARS).
- Initiate work on Full-spectrum Autonomous Sonar Testbed (FAST).

FY 1992 Planned Program:

- Demonstrate laboratory version of FAST system.
- Complete planning for fully autonomous FAST system application to Unmanned Undersea Vehicle (UUV).
- Collect data in field and demonstrate ATARS with recorded data.
- Initiate ASW Battle Management prototype development.

FY 1993 Planned Program:

- Demonstrate FAST at sea aboard U.S. Navy Surveillance Towed Array Sensor System (SURTASS) ship.
- Demonstrate ATARS at sea.
- Demonstrate ASW Battle Management Subsystem.

Program to Completion:

- Complete FAST, ASW UUV demonstrations.
- Complete demonstration of ASW Battle Mangement prototype.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-36

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

D. WORK PERFORMED BY: AT&T-Bell Laboratories, Whippany, NJ; Orincon Corporation, San Diego, CA; Charles Stark Draper Laboratories, Cambridge, MA; Naval Research Laboratory, Washington, DC; Naval Undersea Systems Center, New London, CT; Bolt Boranek and Newman, Cambridge, MA; and General Dynamics, Arlington, VA.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Not applicable.

F. PROGRAM DOCUMENTATION: None.

G. RELATED ACTIVITIES: This program has been fully coordinated with the following programs to ensure that there is no duplication of effort.

- Unmanned Undersea Vehicles are being developed by the DARPA Program Element 0603569E Advanced Submarine Technology Program.
- Surveillance, signal processing and acoustic science technology are being developed Program Element 0602702E in Undersea Warfare Technology Program.
- Office of Naval Technology programs in sonar automation and full spectrum acoustics are addressing selected technology issues.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
FY91	ATARS conceptual design complete.
FY92	FAST components demonstrated.
FY92	ASW Battle Management Prototype design complete.
FY93	FAST demonstrated at sea.
FY93	ATARS demonstration at sea.
FY94	ASW Battle Management Prototype complete.
FY94	ATARS complete.
FY95	FAST system complete.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-37
 Budget Activity: 2. Advanced Technology
Development

A. RESOURCES: (\$ In Thousands)

Project Title: Advanced Simulation

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-37	Advanced Simulation					
	0	8,734	20,800	10,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEMS CAPABILITY:

Developing a seamless warfighting simulation environment for the DoD, aimed at worldwide operation using organic Command, Control, Communications, Computing and Intelligence (C4I) resources. Focus is on development of interoperable technology base which integrates wargames and simulations used by the Services at tactical and operational levels to provide training for optimum force readiness through the right mix of field and computer-assisted exercises involving all echelons of command. This same technology supports the acquisition process through early and continuous prototyping and evaluation of new weapons and support systems as part of the total planned force structure.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- N/A. Previous DARPA efforts funded under other Program Elements.

FY 1991 Planned Program:

- Initiate process for development of wargaming application protocol suite.
- Demonstrate initial protocols for interoperation of wargames, using standard ground and air models.
- Deploy and demonstrate advanced network for distributed wargaming testbed in cooperation with NATO.
- Develop advanced hybrid simulation system for terrain visualization and situation analysis.
- Develop Intelligent Gateways that can couple dissimilar warfighting simulations and support expansion to global scale over wide-area networks.

FY 1992 Planned Program:

- Demonstrate interoperation of multiple ground wargaming models in a distributed network between Europe and continental US.
- Demonstrate prototype Intelligent Gateway supporting interoperation of theater and tactical air simulation models.
- Deploy initial testbed combining distributed command, control, computing and intelligence (C4I) with acquisition/force structure prototyping capability.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced Technology
Development

- Initiate efforts in modelling science to provide a long-term basis for development of advanced interoperable warfighting simulation.
- Initiate technology development for rapid development of simulation terrain base under crisis response.
- Deploy advanced hybrid simulation/C4I system in tactical/operational testbeds.

FY 1993 Planned Program:

- Demonstrate expanded Intelligent Gateway supporting interoperation of theater and tactical ground warfighting simulation models with equivalent air models.
- Expand C4I acquisition/force structure testbed to include a major site from each Service.
- Initiate technology development for integration of field exercises with computer-assisted warfighting simulations.
- Demonstrate rapid simulation terrain base development capability and transfer to Service facilities.
- Transition testbed simulation network to operational status in compliance with Defense directives governing communication.

Program to Completion:

- Complete basic suite of protocols for seamless warfighting simulation.
- Demonstrate intelligent gateways for major critical aspects of aggregation, communications, and live exercise interoperation.

D. WORK PERFORMED BY: Bolt, Baranek, and Newman, Cambridge, MA; Los Alamos National Laboratory, NM; MITRE Corporation, McLean, VA; Simulation Technologies, Inc, Dayton OH; and University of Central Florida, Orlando, FL.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Increase in funding due to consolidation from other funding sources and significantly increased need for distributed simulation capability due to changing world situation.

F. PROGRAM DOCUMENTATION: None.

G. RELATED ACTIVITIES: Related work in technology development is closely coordinated to ensure unnecessary duplication does not occur. New Defense Simulation Management Office in OSD will coordinate such work.

- PE 0602708E/IC01, Integrated Command and Control Technology.
- Service programs in C4I and Warfighting Simulation.

H. OTHER APPROPRIATION FUNDS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced Technology
Development

I. INTERNATIONAL COOPERATIVE: A Distributed Wargaming testbed is being deployed in Europe under a Memorandum of Agreement with SHAPE, now pending OSD review.

J. MILESTONE SCHEDULE:

Plan Milestones

4Q FY92	Demonstrate seamless simulation of combined air, ground logistics and intelligence.
4Q FY93	Demonstrate interoperability of multiple wargaming models.
3Q FY93	Demonstrate intelligent gateway.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-38
 Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Adv Submarine Technology

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
SUBTECH						
EE-38	*	*	30,000	40,000	Continuing	Continuing

*This project was previously funded in PE 0603569E.

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITY: The objective of this project is to develop and demonstrate concepts and to pursue critical enabling technologies for submarine systems. Advanced Submarine Technology focuses on radically reducing the acoustic detectability of current and future submarines. The program also provides the structure for evaluation and validation of acoustic and hydrodynamic quieting designs through analysis and measurement capabilities that do not exist today. Active and passive system technologies will be pursued to reduce radiated noise from submarine machinery and fluid systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Completed Intermediate Scale Measurement System (ISMS) design to quantify multi-directional target strength signature.
- Manufactured and tested thick section composite structures.
- Established Submarine Hydrodynamic/Hydroacoustic Technology Center to permit rapid design assessment.
- Developed advanced hydrodynamic measurement tools.
- Completed design of the Non-Penetrating Periscope (NPP).
- Completed Electric Drive concept studies.

FY 1991 Planned Program:

- Install NPP on R&D Submarine and transition.
- Manufacture and test 1/4-scale composite propulsor and start full-scale fabrication.
- Transition 14 submarine projects to the Navy.
- Conduct advanced hydrodynamic experiments and validate computer codes.
- Manufacture and test thick section composite articles.
- Start ISMS hardware/software development.
- Demonstrate Advanced Vibration Reduction (AVR) components.

FY 1992 Planned Program:

- Transition 11 submarine projects to the Navy.
- Start design of major scale integrated submarine stern.
- Install and test Electromagnetic Countermeasures Launcher on submarine.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-38

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

FY 1993 Planned Program

- Complete design of major scale integrated submarine stern.
- Complete design of four foot thick section composite test articles.
- Construct full-scale prototype of AVR.

Program to Completion: This is a continuing program.

D. WORK PERFORMED BY: AT&T Bell Laboratories, Whippany, NJ; BBN Systems and Technologies, Cambridge, MA; GEC-Marconi, United Kingdom; General Dynamics/Electric Boat Division, Groton, CT; Newport News Shipbuilding, Newport News, VA; Jason Associates, Del Mar, CA; Los Alamos National Laboratory, Los Alamos, NM; McDonnell Aircraft, St. Louis, MO; Sandia National Laboratories, Albuquerque, NM; Applied Physics Laboratory, Laurel, MD; The University of Texas, Austin, TX; Martin Marietta Corporation, Baltimore, MD; and Lockheed Missiles and Space Company, Palo Alto, CA.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: This is a new project. These efforts were previously funded in PE 0603569E.

F. PROGRAM DOCUMENTATION: Not applicable.

G. RELATED ACTIVITIES:

- Program Element 0603561N (Advanced Submarine System Development).
- Program Element 0601153N (Structural Acoustics).

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONES SCHEDULE:

<u>Plan</u>	<u>Milestone</u>
FY91	Test NPP at sea.
FY91	Finalize full-scale design.
FY91	Validate steady hydrodynamic computer codes.
FY91	Demonstrate 1/4-scale propeller bearing.
FY92	At-sea test of propulsor.
FY92	At-sea test of Electromagnetic Countermeasures Launcher.
FY93	Initial operational capability of the ISMS.
FY93	Complete design of major scale integrated submarine stern.
FY93	Finalize AVR component designs.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603226E

Project Number: EE-39

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Unmanned Undersea Vehicle Systems

<u>Popular</u> <u>Name</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
UUV						
EE-39	*	*	20,000	20,000	Continuing	Continuing

* This project was previously funded in PE 0603707E, PP-01.

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITY: The objective of this project is to develop and demonstrate concepts and to pursue critical enabling technologies for unmanned undersea vehicles.

Two specific missions are to be demonstrated: the Tactical Acoustic System (TAS), and the Mine Search System (MSS), a vehicle that can survey an area for mines or lead a host vessel through a minefield. A third system under consideration is the Remote Surveillance System (RSS), a vehicle that would transit, deploy an ASW sensor system, and provide a communication link to enable remote platforms to monitor the sensors.

To make it possible for UUVs to perform more stressing missions, advanced UUV technologies are being developed. In FY91 an improved acoustic communication system will be built and a program will be initiated to develop a high energy density fuel cell for UUV propulsion. In FY92 high precision UUV navigation will also be pursued.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Delivered Unmanned Undersea Vehicles (UUV) #1 and #2 to Tactical Acoustic System (TAS) and Mine Surveillance System (MSS) prime contractors.
- Completed preliminary performance testing of UUV #1.
- Completed integration of the TAS mission electronics into UUV #1.
- Awarded the Mine Search (MSS) mission contract.
- Deployed Acoustic Array from a UUV in support to Remote Surveillance System (RSS).

FY 1991 Planned Program:

- Complete Interim Design Review for the Mine Search System (MSS).
- Initiate advanced acoustic communication system development.
- Complete Tactical Acoustic System (TAS) mission demonstration and transition to Navy for FSD.
- Complete design and fabrication of all Mine Search System (MSS) components and commence integration.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603226E

PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-39

Budget Activity: 2. Advanced
Technology Development

- Complete Critical Design Review for the Mine Search System (MSS).
- Complete Mine Search System (MSS) sonar.
- Continue evaluation of Remote Surveillance System (RSS).
- Award UUV fuel cell contract.

FY 1992 Planned Program:

- Initiate high precision navigation system development.
- Demonstrate underwater laser communication system.
- Complete Mine Search System (MSS) semi-autonomous mine avoidance demonstration.
- Demonstrate improved navigation for MSS mission.
- Continue design and fabrication of UUV fuel cells.

FY 1993 Planned Program:

- Complete Mine Search System Phase II demonstrations.
- Demonstrate fuel cell "brassboard."

Program to Completion: This is a continuing program.

D. WORK PERFORMED BY: Charles Stark Draper Laboratory, Cambridge, MA; Applied Physics Laboratory, Laurel, MD; The University of Texas, Austin, TX; Martin Marietta Corporation, Baltimore, MD; and Lockheed Marine Systems, Sunnyvale, CA; Raytheon Submarine Signal Division, Newport, RI; General Dynamics Applied Remote Technology, San Diego, CA; and Western Instruments Corporation, Oxnard, CA.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: This is a new project. These efforts were previously funded in PE 0603707E.

F. PROGRAM DOCUMENTATION: Not applicable.

G. RELATED ACTIVITIES:

- Program Element 063561N (Unmanned Undersea Vehicle Program). This NAVSEA O6UR program is the "customer" through whom projects developed under the UUV Program are transitioned to the Navy.
- Maintain close coordination with Military Services to eliminate unnecessary duplication.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONE SCHEDULE:

Plan Milestones

FY91	Transition Tactical Acoustic System (TAS) to Navy.
FY91	Deliver Mine Search System (MSS) sonars.
FY91	Initiate advanced acoustic communication system development.
FY91	Award UUV fuel cell contract.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: # 0603226E

Project Number: EE-39

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

FY92 Complete MSS Phase I demonstrations including improved
communications and navigation.
FY92 Demonstrate underwater laser communication system.
FY92 Initiate high precision navigation system development.
FY93 Complete Mine Search System Phase II demonstrations.
FY93 Complete fuel cell "brassboard" demonstrations.

FY 1992/1993 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603227E
 PE Title: Relocatable Target
Detection Technology

Project Number: RT-01
 Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Relocatable Target Detection Technology

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
Relocatable Targets						
RT-01	14,793	21,238	10,000	10,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This program element was created to counter the growing threat of mobile high value tactical and strategic targets that take advantage of natural cover and concealment. The project will demonstrate the integrated technology necessary to satisfy critical U.S. weapon system requirements in the surveillance, target acquisition and engagement against such targets. The technologies selected are designed to exploit enduring target signatures to maintain and expand the U.S. qualitative edge in target detection capability. Sensors are selected to exploit additional sensor dimensions.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Three order of magnitude decrease in false alarm rates using Polarmetric Synthetic Aperture Radar (SAR).
- Successful correlation of outputs of active and passive Infra Red (IR) sensors resulting in improved performance and decreased false alarm rates.
- Successful performance of a near-term sensor against targets.
- Evaluated new sensor.

FY 1991 Planned Program:

- Develop automatic target recognition (ATR) algorithms using polarimetric synthetic aperture radar (SAR).
- Evaluate near-term detector sensor under varying background and high clutter conditions.
- Lab demonstration of passive three dimensional EO/IR images and their ATR algorithms.
- New revolutionary SAR concept will be studied and plans developed for demonstration.

FY 1992 Planned Program:

- Continue development of high resolution, polarimetric SAR for optimum performance and real time implementation.
- Passive, three-dimensional infrared sensor system will be designed and fabricated.
- Demonstration of SAR concept will be initiated.
- A multi-dimensional laser (Ladar) radar system will be developed in the laboratory.

FY 1992/1993 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603227E
PE Title: Relocatable Target
Detection Technology

Project Number: RT-01
Budget Activity: 2. Advanced
Technology Development

FY 1993 Planned Program:

- High resolution polarimetric SAR testbed transitioned to the Services.
- Evaluate passive sensor system against targets in medium to heavy clutter, including automatic target recognition capability.
- Continue development of the SAR to quantify target detection capability.
- Evaluate the multi-dimensional ladar to determine the benefits of imaging, and other signature exploitation techniques.

Program to Completion: The remainder of the program is planned to build, test and evaluate alternative advanced sensor systems for the detection, classification and attack of reduced signature, relocatable and mobile targets.

D. WORK PERFORMED BY: Lincoln Laboratory, Lexington, MA; TOYON, Santa Barbara, CA; Erim, Ann Arbor, MI; and SAIC, Arlington, VA.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: The funding has been reduced due to overall reductions in the DoD budget.

F. PROGRAM DOCUMENTATION: Not applicable.

G. RELATED ACTIVITIES: This program and related Service programs are coordinated with the Department of Defense Steering Committee on Relocatable Targets.

H. OTHER APPROPRIATION FUNDS: None

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Mar 92	Polarimetric SAR/ATR System Demonstration
Aug 93	ZEBRA SHIELD Demonstrations
Nov 92	Imaging Demonstration
Jan 94	SAR Proof of Concept Demonstration
Jun 94	Multidimensional Laser Radar (Ladar) Demonstration.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E

Project Number: PT-01

PE Title: Pre-Competitive Technology Development

Budget Activity: 6. Defensewide Mission Support

A. RESOURCES: (\$ In Thousands)

Project

Number	FY 1990	FY 1991	FY 1992	FY 1993	To	Total
<u>& Title</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
PT-01	Precompetitive Technology Development					
	0	50,000	0	0	0	50,000

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: DARPA intends to fund consortia that could achieve substantial paradigm shifts within the 20 critical national defense technologies. The selection criteria requires that the consortia provide DoD/Industry dual use technology, be included in the DoD critical technologies list, have the potential to achieve a major technology shift, and finally, be fully funded within the FY 1991 funding envelope. The latter criterion requires that a usable produce be demonstrated utilizing only the existing funds or that the consortia would become self-sustaining after the initial government investment. This is an opportunity not only to pursue important technology goals but also to utilize innovative techniques to manage Federal participation in the R&D process. The DoD investment in technology will be leveraged to provide maximum payoff to the Government while improving the pace and quality of the process for transferring technology to industry.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments: Not applicable.

FY 1991 Planned Program:

- Participate with the private sector in precompetitive research on generic, enabling technologies that have the potential to contribute to a broad range of government and commercial applications.
- Maintain a strong Defense technology base to provide options for future weapons systems development and to help avoid technological surprises by potential adversaries.

FY 1992/1993 Planned Program: Not applicable.

D. WORKED PERFORMED BY: Major corporations from the telecommunications, computer, and aerospace industries; universities; and government laboratories.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Manufacturing Technology

Budget Activity: 2. Advanced Technology Development

A. RESOURCES: (\$ In Thousands)

<u>Project Number & Title</u>	<u>FY 1990 Actual</u>	<u>FY 1991 Estimate</u>	<u>FY 1992 Estimate</u>	<u>FY 1993 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
MT-01	Semiconductor Manufacturing Technology (SEMATECH)					
	100,000	100,000	100,000	100,000	Continuing	Continuing
MT-02	Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC)					
	¹ (77,621)	(106,657)	82,018	90,670	Continuing	Continuing
MT-03	IR Focal Plane Array					
	² (20,321)	(18,676)	20,500	21,488	Continuing	Continuing
MT-04	Manufacturing					
	0	0	3,682	13,212	Continuing	Continuing
Total	100,000	100,000	206,200	225,370		

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This program element consolidates three major manufacturing technology programs (SEMATECH, MIMIC, and IR Focal Plane Array) into one single element for Fiscal Years 1992-1997 and initiates a new project (MT-04, Manufacturing) in FY 1992 and FY 1993. The MIMIC project was reported in PE 0603706E, project MM-01 for FY 1991 and prior. The IR Focal Plane Array project was reported in PE 0702807E, project IR-01 for FY 1991 and prior.

Specific project accomplishments and plans and other information are contained in separate project summaries.

¹Funded in PE 0603706E; MM-01.

²Funded in PE 0702807E; IR-01.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
 PE Title: Manufacturing Technology

Project Number: MT-01
 Budget Activity: 2. Advanced
Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Semiconductor Manufacturing Technology

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
SEMATECH	100,000	100,000	100,000	100,000	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides for a major Department of Defense (DoD) effort to develop advanced manufacturing methods for semiconductors used in weapon systems. This program will develop semiconductor manufacturing capabilities to correct deficiencies in the industrial base that have been identified by the Defense Science Board (DSB). This program will stimulate the semiconductor manufacturing industrial base to develop advanced semiconductor materials, processing, equipments and manufacturing methods necessary to regain the superior technology needed for future weapon systems of all types.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Produced Phase II, 0.5 micron chips using American manufactured equipment.
- Defined the key technology thrust areas and programs required to achieve Phase II and Phase III, 0.35 micron objectives.
- Completed construction of all new facilities.
- Completed technology development and manufacturing demonstration of Phase I, 0.8 micron modular processes and transfer to member companies.
- Developed programs to produce equipment and materials to enable the manufacture of high-quality 0.5 micron semiconductor devices.

FY 1991 Planned Program:

- Complete transfer of Phase I technology to member companies.
- Complete installation of Phase II fabrication tools and equipment.
- Demonstrate modular Phase II unit process technology and transfer to member companies.
- Initiate technology development for Phase III unit processes.
- Develop programs to produce equipment and materials to enable the manufacture of high-quality 0.35 micron semiconductor devices.
- Define requirements for post-Phase III, 0.25 micron semiconductor fabrication.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-01

PE Title: Manufacturing Technology

Budget Activity: 2. Advanced
Technology Development

- Demonstrate self-sustaining technology and information infrastructure that will enable the continued development of the highest quality materials, equipment, unit processes, fabrication facilities and management systems enabling the manufacture of world competitive semiconductors for military electronics systems.

FY 1992 Planned Program:

- Complete transfer of Phase II technology to member companies.
- Demonstrate Phase III integrated process and produce first 0.35 micron silicon integrated circuits.
- Initiate technology development for post-Phase III, 0.25 micron unit manufacturing processes.

FY 1993 Planned Program:

- Complete installation and development of Phase III fabrication tools and equipment and transfer to member companies.
- Develop programs to produce equipment and materials that will enable the manufacture of high-quality 0.25 micron semiconductor devices.
- Initiate technology development for 0.18 micron unit manufacturing processes.

Program To Completion:

- Complete installation of 0.25 micron fabrication tools and equipment.
- Produce and demonstrate 0.25 micron fully-integrated process technology and transfer to industry.
- Develop programs to produce equipment and materials that will enable the manufacture of high-quality 0.18 micron semiconductor devices.
- Integrate 0.18 micron unit processes into a fully-integrated manufacturing process.

D. WORK PERFORMED BY: The major performer is the SEMATECH Consortium in Austin, TX.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Consistent with the 1991 Descriptive Summary.

F. PROGRAM DOCUMENTATION: Not applicable.

G. RELATED ACTIVITIES: Exploratory and Advanced Development of semiconductor components are being conducted under Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Strategic Defense Initiative Office (SDIO) Program Elements.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Manufacturing Technology

Project Number: MT-01
Budget Activity: 2. Advanced
Technology Development

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Mar 92	Complete transfer of Phase II technology to member companies.
Jun 92	Produce first Phase III silicon wafers.
Oct 92	Complete installation of Phase III fabrication tools and equipment.
Sept 93	Demonstrate fully integrated Phase III manufacturing process and transfer to member companies.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-02
 PE Title: Manufacturing Technology Budget Activity: 1. Advanced Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Microwave/Millimeter Wave Monolithic Integrated Circuits

<u>Popular</u>	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
MIMIC	1(77,621)	(106,657)	82,018	90,670	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides for a major Defense Advanced Research Projects Agency (DARPA) effort to accelerate the development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits (IC's). Its primary thrust is to develop affordable circuits operating in the 1 to 100 GHz frequency range with required characteristics and in sufficient quantity to satisfy military systems needs. The use of reliable and maintainable semiconductor devices and circuits for selected system demonstrations will be accelerated and, thus, provide the United States with a technological lead in deploying MIMIC-based military systems.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Completed MIMICs on 1,000 wafers (minimum) per contractor team.
- Continued CAD development, processing enhancements, and manufacturing techniques.

FY 1991 Planned Program:

- Deliver all test fixtures, chips, modules, and brassboards from first MIMIC hardware development phase.
- Complete first hardware development CAD system.
- Deliver final test, reliability and quality assurance (QA) plans and test results.

FY 1992 Planned Program:

- Initiate Advanced Technology and System Demonstrations (MIMIC Phase 2).
- Continue enhancement of capabilities to produce devices, circuits and subsystems with needed characteristics.
- Continue integration of CAD capabilities with manufacturing lines and on-line test capabilities.

FY 1993 Planned Program:

- Provide advanced MIMIC computer-aided design (CAD) systems for DoD system contractor use.
- Complete chips and modules for MIMIC Phase 2 demonstrations.
- Reduce testing time for MIMIC modules to 10 minutes/modules.

1Funded in PE 0603706E; MM-01 in FY 1991 and prior.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-02

PE Title: Manufacturing Technology

Budget Activity: 1. Advanced Technology Development

Program To Completion:

- Complete, demonstrate, and deliver MIMIC Phase 2 chips, modules, and brassboards.
- Conduct advanced demonstrations of affordability and expanded system usage.
- Increase emphasis on combined digital, microwave and millimeter wave and optical processing functions on individual chips (or within same package on individual substrates).
- Develop higher performance MIMIC chips from newer material combinations such as indium phosphide based compound structures.
- Continue development of higher power, higher efficiency millimeter wave devices, circuits and subsystems.
- Augment computer aided design capabilities to allow rapid translation of system requirements into circuit and processing specifications.

D. WORK PERFORMED BY: Work will be performed by: Department of the Army, U.S. Army Laboratory Command Electronics Technology & Devices Laboratory; Department of the Navy, Naval Air Systems Command, U.S. Naval Research Laboratory; Department of the Air Force, Wright Research & Development Center, Rome Air Development Center.

Hardware development phase prime contractors are: Hughes/General Electric, El Segundo, CA/Syracuse, NY; Martin Marietta/ITT, Orlando, FL, Roanoke, VA; Raytheon/Texas Instruments, Bedford, MA/Dallas, TX; and TRW, Redondo Beach, CA.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Consistent with FY 1991 Descriptive Summary.

F. PROGRAM DOCUMENTATION:

- Management Structure for the MIMIC Program, 9/85
- Program Plan for MIMIC, 5/86
- Acquisition Plan No. DoD 86-x for MIMIC Program, 10/86
- MIMIC Program Security Classification Guide, DoD Instruction 5210.80, 8/87
- Acquisition Plan No. DoD 87-X for MIMIC Program, 10/87

G. RELATED ACTIVITIES: Exploratory and advanced development of gallium arsenide monolithic components are being undertaken with Army, Navy, and Air Force program elements.

The related program elements and titles are:

- Program Element #0602705A, Electron Devices
- Program Element #0602234N, RF, Microwave, Millimeter Wave Materials, and Devices
- Program Element #0602204F, Microwave Technology

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-02

PE Title: Manufacturing Technology

Budget Activity: 1. Advanced Technology
Development

The work performed under this project within Program Element #0603739E is complementary to the work performed in the above program elements. There is no unnecessary duplication of effort within the Agencies/Services or the Department of Defense.

H. OTHER APPROPRIATION FUNDS: Not applicable.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Feb 91	Fabricate Prototype Modules.
Jul 92	Initiate Advanced Technology and System Demonstrations.
Oct 94	Begin efforts to combine digital, microwave and optical processing functions.
Oct 94	Begin development of microwave and millimeter wave circuit chips from advanced compound semiconductors.
Jan 95	Develop advanced CAD capabilities.
Sep 97	Demonstrate integrated digital, analog and optical function modules in system brassboards.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Project Number: MT-03

Budget Activity: 2. Advanced

Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Infrared Focal Plane Array

Popular

<u>Name</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
IRFPA	20,321*	18,676*	20,500	21,488	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:

The Infrared Focal Plane Array (IRFPA) project establishes a manufacturing base for advanced infrared (IRO) sensor arrays for major weapon systems. Weapon system programs dependent upon the IRFPA include the Advanced Anti-Armor Weapon System-Medium (AAWS-M), the Lightweight Helicopter (LH), the F-14D Infrared Search and Track (IRST) System, the Advanced Missile System-Heavy (AMS-H) and the Advanced Tactical Fighter (ATF). The IRFPA provides the search, target acquisition and tracking sensor for these systems. IRFPAs are currently produced with laboratory technology at low rates, resulting in low yields and high costs. The goal of this program is to produce IRFPAs that meet system requirements at approximately 1% of the current cost. Large area, uniform material wafers, automated wafer inspection, controlled processing modules, and high-throughput testing are major manufacturing initiatives addressed by this program. Integration of these advancements into a manufacturing line, producing IRFPAs in weapon system configurations, will provide affordable IRFPAs in the quantities necessary to meet system needs.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Fabricated 64x64 IRFPAs on large area (2-inch) substrates.
- Demonstrated automated IRFPA testing with a 10 times increase in test throughput.
- Evaluated 480x4 and 64x64 Mercury Cadmium Telluride (MCT) IRFPAs, and 244x400 and 488x512 PtSi IRFPAs designed for target acquisition and missile seeker applications.
- Implemented material defect density reduction increasing physical inspection yield by 40%.

FY 1991 Planned Program:

- Implement automated hybridization equipment increasing throughput x6.
- Demonstrate 960x4, 64x64, 128x128 and 488x512 IRFPAs in laboratory and system field tests.
- Demonstrate material growth reactor for 3-inch substrates.
- Die level automated inspection on-line with 10x reduction in test time.

*Funded under PE 0702807E in FY 1991 and prior.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-03

PE Title: Manufacturing Technology

Budget Activity: 2. Advanced

Technology Development

FY 1992 Planned Program:

- Implement improved material screening to qualify wafers for IRFPA manufacturing.
- Demonstrate in-process sensors for IR material growth to control material uniformity over large wafers.
- Develop the process for damage-free dry etching of contact vias in IR focal plane arrays.

FY 1993 Planned Program:

- Integrate into the manufacturing line vapor phase growth with improved doping control.
- Demonstrate improved screening of infrared (IR) material; x2 increase in the arrays passing wafer-level evaluation.
- Implement manufacturing technology for a 3-inch substrate, incorporating 100 64x64 IRFPAs.
- Manufacture a 960x4 IRFPA with improved reliability (greater than 2,000 thermal cycles without failure).

Program to Completion:

- Manufacturing technology demonstrated for a 64x64 staring array with greater than 90% operability at a cost of less than \$2,000 per array.
- 128x128 IRFPAs demonstrated on a silicon substrate, leading to the goal of an integrated circuit production technology for mercury cadmium telluride.
- IRFPA manufacturing demonstration with four 4-inch wafers.
- Demonstration of manufacturing technology for a multi-spectral array with on-chip processing.
- Large area 512x512 mercury cadmium telluride IRFPA on a silicon substrate demonstrated.
- Complete the development of an integrated manufacturing capability for large area (4-inch wafers) infrared semiconductors demonstrating a 100 times cost reduction for both scanning and staring arrays.

D. WORK PERFORMED BY: In-house work will be performed by: Army, Center for Night Vision and Electro-Optics; Navy, Naval Research Laboratory; Air Force, Manufacturing Technology Office. Contractors include: Rockwell, Anaheim, CA; Texas Instruments, Dallas, TX; Fairchild, Milpitas, CA; Santa Barbara Research Center, Santa Barbara, CA; Perceptronics, Woodlawn Hills, CA.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Consistent with FY 1991 Descriptive Summary.

F. PROGRAM DOCUMENTATION: None.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-03

PE Title: Manufacturing Technology

Budget Activity: 2. Advanced

Technology Development

G. RELATED ACTIVITIES: Development of IRFPA technology and devices is being undertaken under Department of Defense, Army, Navy, Air Force, Defense Advanced Research Project Agency (DARPA), and the Strategic Defense Initiative Office (SDIO) program elements. The related program elements and titles are:

- Program Element 0602709A Night Vision Investigations.
- Program Element 0603774A Night Vision System Advanced Development.
- Program Element 0602334N Systems Support Technology.
- Program Element 0602204F Aerospace Avionics.

The work performed under this project complements work in the above program elements. There is no duplication of effort within the Agencies/Services of the Department of Defense.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. MILESTONE SCHEDULE:

Plan Milestones

May 91	Implement high throughput testing, large area wafer growth and automated wafer inspections.
Aug 91	Evaluate IRFPAs in laboratory evaluations and system field test.
Dec 92	Demonstrate sensors for in-situ control of IR detector manufacture.
Jun 93	Incorporate in-situ sensor control into an integrated process module.
Aug 94	Demonstrate a x100 cost reduction in the manufacture of two-dimensional, staring IFRPAs.
Sept 95	Demonstrate process module concept for multi-spectral scanning arrays.
Dec 96	Demonstrate x100 cost reduction for multi-spectral arrays for infrared search and track and target acquisitions systems.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-04

PE Title: Manufacturing Technology

Budget Activity: 2. Advanced Technology Development

A. RESOURCES: (\$ In Thousands)

Project Title: Manufacturing

<u>Popular</u> <u>Name</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
Manufacturing	0	0	3,682	13,212	Continuing	Continuing

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

Manufacturing technology provides improvements in tools, processes, computer-aided engineering, modeling, computer-integrated manufacturing and concurrent engineering; the results will provide new capabilities and significant productivity improvements in the DoD- dependent industrial base. As a beginning, investments will be made in electronic packaging allowing maximum DoD system performance to be achieved from combinations of integrated circuits at the lowest possible cost. Specific emphasis will be placed upon: (1) establishing production capabilities that allow a wide variety of silicon digital integrated circuits to be efficiently, cheaply and reliably interconnected on silicon wafers in a manner that can improve the capabilities of Department of Defense systems; (2) mounting the wafers on rugged, highly thermal conducting substrates; and (3) establishing techniques to efficiently interconnect packages to systems. Major program goals are: (1) Reducing packaging cost or increasing system performance by an order of magnitude or more for the largest possible number of military applications; (2) Developing computer controlled modular package manufacturing facilities that are flexible in their production capabilities, that can respond rapidly, and will be available and willing to supply packages to all domestic organizations requiring them; (3) Incorporating advanced packaging technologies, as appropriate, to meet performance and cost requirements more effectively; and (4) Providing a mechanism for increasing the number of qualified package manufacturing engineers.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments: Not applicable.

FY 1991 Planned Program: Not applicable.

FY 1992 Planned Program:

- Team of organizations addressing all aspects of the program (e.g. materials, design, facility development, training, quality control, testing) will be established.
- Merchant package suppliers, contractors developing systems for the Department of Defense, universities, Department of Defense and national laboratories, and other organizations will be engaged in packaging production or requirements definition for low-cost, high performance electronic packaging.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-04

PE Title: Manufacturing Technology

Budget Activity: 2. Advanced

Technology Development

FY 1993 Planned Program:

- Program definition phase concludes with selected performers beginning the design, manufacture and testing of the required packages.

Program To Completion:

- Manufacturing facility in place with the first package demonstrated. Facility operating at high volume.

D. WORK TO BE PERFORMED BY: To be determined.

E. COMPARISON WITH FY 1991 DESCRIPTIVE SUMMARY: Not applicable; FY 1992 new start.

F. PROGRAM DOCUMENTATION: None.

G. RELATED ACTIVITIES: This effort will be closely coordinated with Project MT-01 (SEMATECH) and other DARPA/Service activities related to manufacturing, such as X-Ray Lithography, and MIMIC (MT-02). There is no unnecessary duplication with other DoD or Service programs.

H. OTHER APPROPRIATION FUNDS: None.

I. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestone</u>
1Q 1992	Definition phase initiated.
1Q 1993	Definition phase completed, teams formed, technical & business plans completed.
1Q 1994	Facility in place, first package demonstration.
2Q 1995	Line complete; first customers.
2Q 1996	Facility operating at high volume.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
 PE Title: Consolidated DoD
Software Initiative

Budget Activity: 2. Advanced Technology
Development

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
CS-01	DoD Software Engineering Institute (SEI)					
	28,500	19,000	17,100	17,100	Continuing	Continuing
CS-02	Software Technology for Adaptable Reliable Systems (STARS)					
	<u>16,694</u>	<u>15,572</u>	<u>26,900</u>	<u>28,900</u>	Continuing	Continuing
TOTAL	45,194	34,572	44,000	46,000		

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: The consolidated Department of Defense (DoD) Software Initiative includes the DoD Software Engineering Institute (CS01 - SEI) and the Software Technology for Adaptable, Reliable Systems (CS02 - STARS) program. STARS will invent and demonstrate new technologies and model new acquisition practices needed to reduce the cost and increase the reliability of military software, particularly for systems requiring large amounts of software. The SEI will accelerate the transition of new computer software technology into use in military weapon systems.

FY 1992/93 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
 PE Title: Consolidated DoD
Software Initiative

Project Number: CS-01
 Budget Activity: 2. Advanced Technology
Development

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number</u> <u>& Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
CS-01 SEI	28,500	19,000	17,100	17,100	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This project funds the Software Engineering Institute (SEI) to accelerate transition of software technology into the Services and industry to meet the demands for quality software and to advance the state of software engineering practice for use in development of weapon systems. The SEI identifies software engineering concerns critical to defense systems, identifies research that could be applied to such problems, and then works with the research community, industry and government organizations to rapidly transition appropriate technology to defense use. The need for the SEI was documented in the reports of the Department of Defense (DoD) Joint Task Force for Software Technology for Adaptable, Reliable Systems, March 1983, and by the blue-ribbon industry/Academia SEI Study Panel administered by the Institute for Defense Analysis for the Office of the Deputy Under Secretary of Defense (ODUSD) (R&AT), November 1983 and reaffirmed by the SFI joint Advisory committee in January 1989.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Completed the F-14 and F-16 post deployment software support (PDSS) process models.
- Delivered a user interface prototyping system for C3I applications.
- Initiated cooperative evaluation of Computer Aided Software Engineering (CASE) tools for defense applications.
- Completed distributed Ada real time kernel.
- Expanded the video based education program to the DoD and industry including intelligent video tutoring.
- Continued workshops, conferences, seminars, and specialized direct support.
- Completed continuing education course development with Air Force Institute of Technology (AFIT).
- Initiated risk assessment program.
- Operated and improved Computer Emergency Response Team (CERT) capability.

FY 1991 Planned Program:

- Deliver tool for managing software configuration.
- Initiate development of improvement technique for DoD software program management.
- Initiate intelligent interactive requirements elicitation system development.

FY 1992/93 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD
Software Initiative

Project Number: CS-01
Budget Activity: 2. Advanced Technology
Development

- Complete preliminary data analysis and initial forecast for software capacity model.
- Produce initial version of Software Technology for Adaptable, Reliable Systems (STARS) process building blocks and metrics definition.
- Produce initial software risk assessment capability.
- License software process assessment methodology to at least four vendors.
- Complete requirements definition for Ada 9x.

FY 1992-93 Planned Program:

- Extend software process assessment capability.
- Support evaluation and transfer of STARS environment technology.
- Evaluate and extend software engineering education capabilities, including curriculum, course materials.
- Continue to operate and improve Computer Emergency Response Team (CERT). Initiate collaborative computer system protection research.
- Apply and extend software risk management capabilities.
- Extend and accelerate use of Ada Technology.
- Continue workshops, conferences, seminars, and specialized direct support.

D. WORK PERFORMED BY: Management and support will be performed by DARPA and the Military Services as appropriate. Major contractor is Carnegie-Mellon University, Pittsburgh, PA. The SEI is a federally-funded research and development center.

E. RELATED ACTIVITIES:

0603756E STARS
0602301E Intelligent Systems (ST-11)
0601101E Information Science (CCS-02)

The activities are managed by a team of software program managers under the control of the Director, DARPA Information Science and Technology Office, to ensure that there is no duplication of effort among the programs.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD
Software Initiative

Project Number: CS-02
Budget Activity: 2. Advanced Technology
Development

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
CS-02	STARS 16,694	15,572	26,900	28,900	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: Software is one of the top items on the DoD Critical Technologies list. The Software Technology for Adaptable, Reliable Systems (STARS) program is generating three key integrating elements upon which to build a coordinated DoD software solution: a set of Software Engineering Environments (SEEs); a set of modern, tailorable software life-cycle process building blocks; and a software asset library capability to facilitate software productivity. The SEEs will be composed of commercially-supported products with open interfaces to stimulate the Computer Aided Software Engineering (CASE) tools marketplace. The SEEs will reinforce use of modern process models, have seamless interfaces to reuse libraries and will be evaluated on current DoD programs, thus ensuring a new technology base for future DoD software programs.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments:

- Analyzed the three STARS, SEEs and prototyped critical elements.
- Evaluated SEE capabilities to support a more open architecture and programming-in-the-large.
- Initiated specification of STARS process model building blocks, open environment interfaces, and evaluation metrics.
- Established initial STARS software asset library capabilities.
- Investigated integrity policies for enhanced software reliability through mandatory, computer controlled configuration management.

FY 1991 Planned Program:

- Establish STARS baseline software engineering environment (SEE) open architecture.
- Establish and refine STARS software asset library capabilities.
- Determine STARS-SEE evaluation applications areas and initiate selection process.

FY 1992 Planned Program:

- Initiate three integrations of Software Technology for Adaptable, Reliable Systems (STARS)-Software Engineering Environments (SEE) architectures.
- Select SEE evaluation applications projects.
- Begin integration of process mechanisms and reuse asset library mechanisms into the three SEEs.
- Evaluate and extend STARS software asset library capabilities.
- Begin populating STARS SEEs with tools.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603756E
PE Title: Consolidated DoD
Software Initiative

Project Number: CS-02
Budget Activity: 2. Advanced Technology
Development

FY 1993 Planned Program:

- Complete STARS-SEE initial operational capability.
- Prepare applications projects for trial SEE use.
- Establish SEE evaluation capabilities.
- Evaluate and extend software asset library capabilities.
- Tailor STARS SEEs, asset libraries, and process building blocks for use on evaluation application Project.
- Complete initial population of STARS-SEE tool capabilities.
- Prepare for government evaluation of STARS program based on the use of the STARS SEEs on evaluation application programs.
- Refine and begin execution of plan for transition of STARS Technology.
- Plan for transition of software asset library to become self supporting.

D. WORK PERFORMED BY: Boeing Aerospace Corporation, Kent, WA; IBM Systems Integration Division, Gaithersburg, MD; UNISYS, McLean, VA, and their subcontractors.

E. RELATED ACTIVITIES:

- 0604740F, Computer Resource Management Technology.
- 0603728F, Advanced Computer Technology.
- 0603723A, Command and Control.
- 0602746A, Tactical Automated Data Processing Technology.
- 0603526N, Advanced Computer Technology.
- 0603756E, Software Engineering Institute (SEI).
- 0601101E, Information Science (CCS-02).
- 0602301E, Intelligent Systems (ST-11).
- The activities above are managed and controlled by the Director, Information Science and Technology Office, at DARPA to ensure that there is no duplication of effort among the programs.

F. OTHER APPROPRIATION FUNDS: Not applicable.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

FY 1992/1993 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E
PE Title: Management Headquarters

Project Number: MH-01
Budget Activity: 6. Defensewide
Mission Support

A. RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1990</u> <u>Actual</u>	<u>FY 1991</u> <u>Estimate</u>	<u>FY 1992</u> <u>Estimate</u>	<u>FY 1993</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MH-01 Management Headquarters	16,727	17,778	17,667	17,839	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT/PROJECT: This program element provides funds for administrative support costs of the Defense Advanced Research Projects Agency (DARPA). This funding provides for the personnel compensation and benefits for civilians assigned to DARPA as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

C. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1990 Accomplishments: Funding under this program element in FY 1990 supported management and administration for the RDT&E program assigned to DARPA. The majority of the funds were required for the pay of personnel who operate the Agency. This project also includes funding to reimburse the various Service agents for costs associated with their administration of DARPA's contracts.

FY 1991 Planned Program: DARPA will continue the basic management and administrative support efforts for headquarters at approximately the same level plus funds associated with the planned relocation of DARPA's headquarters office.

FY 1992 Planned Program: DARPA will continue the management and administrative headquarters support at approximately the same level as FY 1991. In addition, funds are included for planned improvements in physical and information security.

FY 1993 Planned Program: DARPA will continue management and administrative headquarters support at about the same levels as in FY92.

D. WORK PERFORMED BY: Civilian and military personnel assigned to the DARPA and by DARPA agent personnel operating within the Military Services.

E. RELATED ACTIVITIES: Not applicable.

F. OTHER APPROPRIATION FUNDS: None.

G. INTERNATIONAL COOPERATIVE AGREEMENTS: None.

END